100% DESIGN ANALYSIS

HIMCO DUMP SUPERFUND SITE
FINAL LANDFILL CLOSURE
ELKHART, INDIANA

Prepared For:

EPA United States Environmental Protection Agency

Region 5
Chicago, Illinois

Prepared By:

US Army Corps
of Engineers
Omaha District

APRIL 1998

100% DESIGN ANALYSIS
FOR
REMEDIAL ACTION
HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA

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ACRONYMS

AASHTO:	American Association of Highway And Transportation Officials
ACGIH:	American Conference of Governmental Industrial Hygeniest
AOS:	Apparent Opening Size
APR:	Air Purifying Respirator
ASCE:	American Society of Civil Engineers
ARAR:	Applicable or Relevant and Appropriate Requirements
ASTM:	American Society for Testing and Materials
CDQM:	Chemical Data Quality Management
CERCLA:	Comprehensive Environmental Cleanup and Liability Act??
cfm:	cubic feet per minute
CFR:	Code of Federal Regulations
CIH:	Certified Industrial Hygeneist
cm/s:	centimeters per second
cfs:	cubic feet per second
COD:	Chemical Oxygen Demand
CRZ:	Contamination Reduction Zone
DA:	Design Analysis
DAPPER:	Distribution Analysis for Power Planning, Evaluation, and Reporting
EPA:	Environmental Protection Agency
ER:	Engineering Regulation
EZ:	Exclusion Zone
F:	Fahrenheit
FIT:	Field investigation Team
fps:	Feet per second

ACRONYMS

ft:	Feet
ft/ft:	Feet per foot
g:	Gravity
GCL:	Geoysnthetic Clay Liner
gpm:	gallon per minute
HEC:	Hydrologic Engineering Center
HELP:	Hydrologic Evaluation of Landfill Performance
HDPE:	High Density Polyethylene
IAC:	Indiana Administrative Code
ISBH:	Indiana State Board of Health
LFG:	Landfill Gas
LGAC:	Liquid-Phase Granular Activated Carbon
LGP:	Low Ground Pressure
MCL:	Maximum Contaminant Level
mg/kg:	milligram per kilogram
mg/m^3:	milligram per meter cubed
mph:	miles per hour
msl:	Mean Sea Level
MUSLE:	Modified Universal Soil Loss Equation
NAD:	North American Datum
NEC:	National Electric Code
NEMA:	National Electrical Manufacturers Association
NIOSH:	National Institute for Occupational Safety and Health
NMOC:	Nonmethane Organic Compounds

ACRONYMS

NOAA:	National Oceanic and Atmospheric Administration
NPDES:	National Pollution Discharge Elimination System
NPL:	National Priority List
NWS:	National Weather Service
O&M:	Operations and Maintenance
OM&M:	Operations, Maintenance, and Monitoring
OSHA:	Occupational Health and Safety Administration
PCB:	Polychlorinated byphenols
pcf:	pounds per cubic foot
PEL:	Permissable xposure Level
POTW:	Publicly Owned Treatment Works
ppb:	parts per billion
PPE:	Personnel Protective Equipment
PRP:	Potentially Responsible Party
psi:	pounds per square inch
PVC:	Polyvinyl chloride
Q:	Flow
QAPP:	Quality Assurance Project Plan
QSI:	Quadrel Services, Inc.
RCP:	Reinforced Concrete Pipe
RI/FS:	Remedial Investigation/Feasibility Study
ROD:	Record of Decision
ROG:	Reactive Organic Gases
SCBA:	Self-Contained Breathing Apparatus
SOP:	Standard Operating Procedures

ACRONYMS

SSHO:	Site Safety and Health Officer
SSHP:	Site Safety and Health Plan
SVOC:	Semi-Volatile Organic Carbons
TLV:	Threshold Limit Value
TM:	Technical Manual
TSD:	Temporary Storage and Disposal
ug/l:	Micrograms per Liter
USACE:	United States Army Corps of Engineers
USEPA:	United States Environmental Protection Agency
USGS:	United States Geological Survey
USLE:	Universal Soil Loss Equation
VGAC:	Vapor-Phase Granular Activated Carbon
VOC:	Volatile Organic Carbons
yr:	Year

1. INTRODUCTION.

1.1. GENERAL. This document contains the Design Analysis (DA) prepared by the United States Army Corps of Engineers (USACE)-Omaha District for the Himco Dump Superfund Site remedial action. The DA was prepared in support of the remedial action required by the Record of Decision (ROD) for this site as discussed in following sections of this report. The drawings and specifications were prepared for a Potentially Responsible Party (PRP) lead in construction (i.e., USACE will not administer the construction phase of the remedial action).

1.2. AUTHORIZATION. This project was authorized by the United States Environmental Protection Agency (USEPA) Interagency Agreement No. DW96947722-01-0 dated 24 March 1995.

1.3. SITE LOCATION AND DESCRIPTION. The Himco Dump Superfund Site is a closed landfill which operated from approximately 1960 to 1976. The landfill is located adjacent to County Road 10 and John Weaver Boulevard (Nappanee Street Extension) in the City of Elkhart, Elkhart County, Indiana (See Figures 1 and 2). Overall, the Himco Dump Superfund Site covers approximately 100 acres in the northeast quarter of Section 36, Township 38 North, Range 4 East, in Cleveland Township. Of the 100 acres, approximately 58 acres were utilized as a landfill. The site is bounded on the north by woodlands, farm fields, and an abandoned quarry pond; on the west by two ponds and fields; on the south by County Road 10 and private residences; and on the east by John Weaver Boulevard. The site is located approximately two miles north of the St. Joseph River which runs east-west through the City of Elkhart. According to Federal Emergency Management Agency flood insurance rate maps for Elkhart, the Himco Dump Superfund Site is located well outside the designated floodplain for the James River.

The landfill and surrounding areas were initially marshes and grasslands. The existence of marshes and grasslands have been confirmed by examination of historic aerial photographs and during USACE subsurface investigation activities where peat like layers were observed in the soil stratigraphy. The landfill was not an engineered facility and did not have a liner, leachate collection system, or gas recovery system. Refuse was placed at ground surface across the site, with the exception of trench filling in the eastern area of the site. In this area, a total of five trenches 10 to 15 feet deep, the width of a truck and 30 feet long, were excavated. Paper refuse was reportedly dumped in the trenches and burned. About two-thirds of the waste in the landfill is reportedly calcium sulfate from Miles Laboratories. As much as 360 tons per day were disposed of at the landfill over an unspecified time period. Other wastes accepted at the landfill included demolition/construction debris, household refuse, and industrial and hospital wastes. Sandy soils utilized for landfill operations and closure were obtained primarily from an abandoned gravel pit to the north, ponds to the west, and essentially anywhere around the perimeter of the site where soil was available. In 1976, the landfill was closed and covered. The cover reportedly consists of approximately one foot of sandy soil overlying waste.

Currently, there are two points of access to the site. The primary point of access is located near the southeast corner of the landfill near the intersection of County Road 10 and John Weaver Boulevard. A second point of access is located near the northeast corner of the site. Existing site conditions are presented on the Drawings GE.01 through GE.04. An abandoned gravel pit, now commonly referred to as the quarry pond, is filled with water to a depth of approximately 30 feet. Two other smaller and shallower ponds located on the west side of the landfill are commonly referred to as the "L" pond and the small pond. An area, densely vegetated in places, located south of the main landfill and north of County Road 10 is referred to as the "construction debris area." Numerous small piles of rubble, concrete, asphalt, and metal debris are scattered throughout this area. The highest elevation on the site is approximately 774.5 feet above mean sea level (ft msl). The typical ground surface elevation surrounding the mounded landfill area is approximately 762 ft msl.

Eleven monitoring wells and approximately 16 United States Geologic Survey (USGS) observation wells were located on or immediately adjacent to the Himco site prior to pre-design activities. As part of the pre-design investigative activities for this project, USACE installed an additional 12 groundwater monitoring wells.

1.4. POPULATION AND LAND USE. Elkhart has a population of around 40,000 in an approximately 17 square mile area. Within a one mile radius of the site, land use is residential, commercial, industrial, and agricultural. Approximately one-third of the site itself has been used agricultural purposes (i.e., soybean and corn production).

1.5. SITE ENFORCEMENT HISTORY. In 1971, the Indiana State Board of Health (ISBH) first identified the Himco site as an open dump. In early 1974, residents along County Road 10 south of the landfill complained to ISBH about color, taste, and odor problems with their shallow wells. Analyses of six shallow wells along County Road 10 by the State showed high levels of manganese. In 1976, the landfill was closed and covered. As noted previously, the cover reportedly consists of approximately one foot of sand overlying waste and calcium sulfate.

In 1984, a field investigation team (FIT) conducted a site inspection at the Himco site. Laboratory analysis from a number of the existing USGS monitoring wells showed that groundwater down-gradient of the site was contaminated by volatile organic carbons (VOCs), semi-volatile organic carbons (SVOCs) and metals. At the time of the FIT site inspection, leachate seeps were observed in the landfill area.

In June 1988, the Himco Dump was proposed for the National Priorities List (NPL). The site was officially designated as a NPL site in February 1990. In July 1989, USEPA issued a work assignment to SEC Donohue to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the site. From 1990 through 1991, SEC Donohue conducted the RI/FS study for the site. Activities completed included excavation of test pits, installation of monitoring wells, and collection of soil, landfill gas, surface water, sediment, leachate, and groundwater samples for chemical analysis. During the RI/FS, a "hot spot" of contamination was identified in an area near the southwest border of the landfill proper just north of the construction debris area as shown in Figure 2. A leachate sample from this area contained approximately 50 percent by weight toluene and other VOCs. USEPA conducted a site assessment at the identified "hot spot" area in 1992 and verified a high level of VOC contamination in this area. In response to this finding, USEPA conducted an emergency removal action on 22 May 1992 which led to the identification and removal of seventy-one 55-gallon drums containing various liquids from this area.

In 1993, USEPA signed the ROD for the site. The ROD, which is summarized in the following section, prescribed the selected remedial action for the site.

1.6. RECORD-OF-DECISION. The purpose of the selected remedial action, as specified in the ROD, is to eliminate or reduce the migration of contaminants to groundwater and to reduce risks associated with exposure to contaminated materials. Refer to Appendix L for a copy of the ROD. The major components of the remedial action, as prescribed in the ROD, are listed below.

- Construction of a composite barrier, solid waste landfill cover (cap) consisting of the following components:
  - 18-inch thick vegetative soil layer,
  - 6-inch thick sand drainage layer,
  - 40 millimeter high density polyethylene (HDPE) flexible membrane liner (geomembrane), [The intent of the ROD was to specify a 40 mil thick geomembrane, a 40 millimeter geomembrane is approximately 1.5 inches thick]
  - 2-foot thick low permeability clay liner, and a
  - Soil buffer layer of variable thickness to attain State of Indiana grade requirements (4 percent minimum).

- Use of institutional controls on landfill property to limit land and groundwater use.

- Installation of an active landfill gas collection system including a vapor phase carbon system to treat the off-gas from the landfill.

- Monitoring of groundwater to ensure effectiveness of the remedial action and to evaluate the need for future groundwater treatment.

- Mitigative measures will be taken during remedial construction activities to minimize adverse impacts to wetlands.

1.7. ROD MODIFICATIONS. The final landfill cover system components have been modified from the ROD specified components by substituting a geocomposite drainage layer for the sand drainage layer and substituting a geosynthetic clay liner for the low permeability clay layer.

Final cover system components, from top to bottom, are:

- Turf (Vegetative Cover),
- 6-inch thick topsoil layer,
- 18-inch thick select fill layer,
- Geocomposite,
- HDPE Geomembrane (40 mil)
- Geosynthetic Clay Liner,
- 12-inch thick foundation layer, and
- Random fill and regraded refuse of variable thickness to attain State of Indiana grade requirements (4 percent minimum).

2. PRE-DESIGN

2.1. INTRODUCTION. In order to proceed from the ROD to preparation of plans and specifications for the landfill's cover system, pre-design investigations were conducted to fill data gaps. Information from the pre-design investigation is presented in the following sections.

2.2. SURVEYS AND MAPPING.

2.2.1. Topographic Survey. A topographic survey of the entire site was supplied to USACE by USEPA. The aerial topographic surveys were prepared by Lang, Feeney and Associates, Inc. of South Bend, Indiana under subcontract to SEC Donohue during the RI/FS. Topographic mapping was interpolated from a photogrammetric survey conducted on 13 November 1990. The surveys were completed in Autocad V.10 format by the survey contractor. USACE converted the drawings to MicroStation Intergraph format for design. The surveys were adequate to complete the design of the landfill cover system. Additional surveys were performed during pre-design to verify the coordinates and elevations of existing groundwater monitoring wells and to determine coordinates and elevation of new monitoring wells. Site conditions at the time of the survey are presented on Drawings GE-01 through GE-04.

2.2.2. Boundary Survey and Property Search. A boundary survey and property search was performed by Lang, Feeney and Associates, Inc. for this project during the RI/FS. This information was supplied to USACE and has been incorporated into the design. Refer to Drawings G4.01 and G4.02 for property boundary delineation and ownership. Prior to construction, an updated property search will be required in order to obtain rights-of-entry and for property acquisition purposes. As identified in the 1992 RI/FS, the primary owners of property in the landfill proper area (not including the construction debris area) are:

- Miles Laboratory,
- CLD Corporation,
- Alonzo Craft, Jr., and
- Indiana and Michigan Electric Company.

In addition to the land owners listed above, numerous individuals own property in the construction debris area.

2.2.3. Survey Horizontal and Vertical Control. Lang, Feeney and Associates, Inc. established horizontal and vertical control based upon NAD 83 and State of Indiana horizontal grid coordinates. Several temporary control points were located during a 29 August 1995 site visit. Large painted crosses identified the locations of several control points. A concrete nail is located in the median island at the intersection of County Highway 10 and John Weaver Boulevard (N1531280.00, E407956.06, Elevation 761.45 ft msl). A second concrete nail is located in the south lane of County Highway 10 approximately one half mile west of the above described intersection (N1531937.11, E405292.80, Elevation 761.43 ft msl). Refer to Drawings G4.01 and G4.02 for horizontal and vertical control information. The contractor will need to verify existing control and establish additional control for construction.

2.2.4. Utility Locations. On-site above and below ground utilities locations were obtained from local utility companies and subsequently shown on the project drawings. The construction contractor will need to verify utility information prior to implementing remedial action. A list of utility companies is provided below.

•Public Works and Utilities, City Of Elkhart, Indiana
1201 South Nappanee Street
Elkhart, Indiana 46516
•Indiana Michigan Power Company
3340 U.S. 20 East
Elkhart, Indiana 46516
•Northern Indiana Public Service Company
300 East Kercher Road
Goshen, Indiana 46526
•GTE
8001 West Jefferson Boulevard
Fort Wayne, Indiana 46804

2.3. PREVIOUS SITE INVESTIGATIONS AND RESULTS.

2.3.1. General. As discussed previously, USEPA conducted a limited site investigation in 1984. This investigation consisted of chemically analyzing groundwater samples collected from numerous wells located on, or adjacent to, the site. The results of this investigation led to a RI/FS. A summary of the findings and results of the RI/FS are provided below. A complete discussion of findings and results is presented in RI and FS reports (SEC Donohue, 1992a, b, c, d, e,)

2.3.2. Landfill Limits. The areal extent of the landfill was estimated using a combination of geophysical survey, test pits and soil borings, soil gas surveys, examination of the site historic aerial photographs, and site visits. Based on this investigation, the landfill boundaries were delineated as presented on Drawings G1.01. The area of the landfill is approximately 58 acres. The construction debris area occupies approximately 4 of the 58 acres. Landfill boundaries for design compare closely with the delineation of landfill limits that were presented in the RI/FS. The design limits of the landfill will be verified during construction by excavating and inspection trench around the perimeter of the landfill cover.

2.3.3. Landfill Waste Characteristics. Municipal waste, such as paper, plastic, wood, and household products, was found in all trenches excavated during the RI where waste was encountered. Metal wastes and other construction debris were frequently found mixed with the debris. The largest concentrations of metal, such as drum pipes and sheet metal, were found in the southern area of the landfill. Other construction debris was observed in the south central and southwest edge of the landfill in the "construction debris area" described previously. No calcium sulfate was found in this area. Specific construction debris items observed included concrete chunks, concrete slabs, bricks, plywood, cinder blocks, cobbles, boards, wire, glass, and small asphalt chunks. The thickness of construction debris in the construction debris area varied. Debris was generally thicker in the eastern half of this area as compared to the western half. In the eastern half of the construction debris area, debris was encountered to a depth of at least 11 feet below existing ground level. Trench logs are presented in Appendix E. Using an estimated area of 58 acres and assuming average waste depths of 9 and 13 feet, the total estimated waste volume in the landfill ranges from approximately 900,000 to 1.2 million cubic yards.

2.3.4. Soil Gas Survey. Waste mass gas sampling was conducted on the landfill cover soils during the RI in order to characterize the extent of volatile organic compounds in the landfill. Sixteen soil gas samples were collected from the landfill. Various VOCs were detected in 14 of 16 samples. The concentration of total VOCs was less than 1 part per billion (ppb) in 12 of 14 samples. VOCs at the other two locations totaled 9.8 ppb and 12.2 ppb. In addition to cover soil sampling, four residences along County Road 10 were screened for the presence of landfill gases (methane and hydrogen sulfide). These gases were not detected. A passive soil gas survey was conducted during pre-design as discussed in Section 2.5.

2.3.5. Soil Contamination. Contaminants were detected primarily in surface soils. Arsenic and beryllium were detected in surface samples located across the western half of the site, around the quarry pond, and in the south central area. The highest concentrations of arsenic were detected in soil samples from the south central area. Beryllium was detected at several locations at relatively consistent concentrations. VOCs were detected in many places across the site at low concentrations. SVOC contamination was most prominent in soil samples collected in the south-central area. Pesticides were also detected in two soil samples collected from this area.

2.3.6. Leachate. Leachate was encountered in several of the test pits or trenches excavated in both the construction debris area and the landfill proper area of the site. At the time the RI was conducted, leachate did not appear to be significantly impacting groundwater based on groundwater sampling results. Leachate was sampled at four locations and analyzed for VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), metals, cyanide, and several water quality parameters (e.g., alkalinity, bromide, chemical oxygen demand (COD), and chloride). Concentrations of VOCs and inorganic contaminants detected in leachate were typically orders of magnitude higher than groundwater concentrations. In addition, some VOCs and SVOCs which were detected in leachate were not detected in groundwater. Leachate from trench TL-5 (located in the "hot spot" area), separated into two phases of almost pure product and leachate. Analysis of the pure product phase showed 50 percent toluene.

2.3.7. Surface Water and Sediment Analysis. Surface water and sediments were sampled from the three site ponds. Analytical results did not reveal significant contamination. Inorganic concentrations were similar to background levels, except for antimony in sediments from the quarry pond which exceeded background levels. Pesticides and PCBs were not detected in any surface water or sediment samples collected from the three site ponds. VOCs were detected at low concentrations in both surface water and sediment samples (i.e., less than 6 micrograms per liter (ug/l) in surface water and close to background in sediment). Methylene chloride was detected at concentrations ranging from 6 to 120 ug/l in surface water; however, this contamination may have been a laboratory artifact. Only low concentrations of SVOCs were detected in surface water samples.

2.3.8. Groundwater Contamination. Two rounds of groundwater sampling were conducted during the RI. These two rounds of groundwater sampling revealed very limited groundwater contamination outside the boundaries of the landfill. In general, trace amounts of VOCs and SVOCS were detected in groundwater samples. During the first round of sampling, trichloroethane exceeded its maximum contaminant level (MCL) of 5 ug/l in two USGS wells, J1 and J2, which are located approximately 2,000 feet off-site and side gradient of the landfill. Pesticides were not detected in any groundwater samples collected.

In the wells south of the landfill, MCL's for nine chemicals were exceeded at least once; however, it had not been established in the RI/FS that the contamination resulted from the site. Most contaminants were inorganics (antimony, arsenic, beryllium, chromium, lead, nickel, and sulfate), although low levels of VOCs were detected. Beryllium contamination was at similar concentrations in background wells. Arsenic and antimony were detected at significantly higher concentrations than in background wells. Except for beryllium, nickel, and sulfate, all chemicals which exceeded MCLs south of the landfill also exceeded MCLs in trench leachate samples. Additional groundwater sampling was conducted during pre- design as discussed in Section 2.4.

2.3.9. Geology. The stratigraphy beneath the site was characterized during the RI as sand and gravel outwash deposits comprised of alternating beds of poorly-to well-graded sands and gravels, and gravel-sand-silt mixtures ranging from approximately 200 to 500 feet below ground surface. These outwash deposits constitute the primary groundwater aquifer at the site. Minor seams of silt and clay were also encountered, but there was no indication of a consistent confining layer beneath the site.

2.3.10. Groundwater Levels. During the RI/FS, groundwater was located between approximately 5 and 20 feet below the ground surface at the site. The water level in the three ponds represents the surface expression of the water table at the site. Groundwater flow during the RI/FS was generally to the south-southeast towards the St. Joseph River, which is a regional groundwater discharge for this area. Groundwater recharge is from under flow from the north and from surface water infiltration. The average horizontal flow gradient beneath the site was approximately 0.0016 feet per foot (ft/ft). Vertical gradients were predominantly upward and ranged from 0.00021 ft/ft to 0.0013 ft/ft. Calculated field hydraulic conductivities ranged from 0.12 to 0.00079 centimeters per second (cm/s), with an average value of 0.0022 cm/s. The historic fluctuation of groundwater at the site is relevant to construction of the cover system and borrow and wetland mitigation areas. Table 2-1 presents historic groundwater elevation in wells located on or adjacent to the site over the period of 1980 to 1989. As shown in Table 2-1, groundwater has fluctuated four to six feet in elevation over the period monitored.

TABLE 2-1
HISTORIC GROUNDWATER FLUCTUATIONS
1980 to 1989

Well Designation	Groundwater Elevation (feet msl)		
	Mean	Minimum	Maximum
B1	756.29	754.48	758.38
B2	756.27	754.23	759.23
B3	756.29	754.37	758.25
B4	756.10	754.27	758.19
D1	754.71	751.72	757.39
D2	754.92	753.03	760.14
D3	754.70	753.02	757.32
E1	752.75	750.70	755.46
E2	752.84	749.26	755.63
E3	752.77	750.91	755.43
M1	753.15	751.26	755.85
M2	753.32	751.15	757.15
O1	753.11	751.36	756.12
P1	752.44	750.41	755.55

2.4. PRE-DESIGN GROUNDWATER SAMPLING AND ANALYSIS.

2.4.1. General. During pre-design, USACE installed additional groundwater monitoring wells and performed one round of groundwater sampling in the late summer and fall of 1995. A complete discussion of the results of USACE groundwater sampling is presented in *Final Pre-design Technical Memorandum*, Himco Dump Superfund Site dated March 1996. A summary of results is presented below.

2.4.2. Summary of Results. In general, analytical results from the pre-design investigation confirmed and extended the analytical findings of the RI in that contaminants in the groundwater attributable to the landfill continue to migrate off-site. Groundwater quality both up- and down-gradient from the site does not appear to have changed significantly since the RI sampling events with regards to metals, VOC's, SVOC's, pesticides, and PCB's. During the pre-design investigation, construction debris was encountered in borings for monitoring wells WT116A and WT116B. USACE drill logs are presented in Appendix D. Groundwater samples from monitoring well WT116A yielded detects of benzene at 15 ug/l which is above the current MCL of 5 ug/l and numerous previously unreported SVOC's. Groundwater was encountered from approximately 3 to 16 feet below the ground surface at elevations ranging from 751 to 757 ft msl. Groundwater elevations showed a relatively flat horizontal hydraulic gradient (average of 0.001 ft/ft) tending south to southeast in the shallow and intermediate portions of the water table aquifer.

2.5. PRE-DESIGN LANDFILL GAS INVESTIGATION.

2.5.1. General. A study of the quantity and distribution of gases produced by the landfill was necessary for design of the landfill gas collection and treatment system. Landfill gas (LFG) is generated from the biological decomposition of organic waste in the waste mass. Generally, LFG is comprised of about half methane and half carbon dioxide with a small quantity of other gases. Methane is flammable, colorless, odorless, and tasteless and is explosive in the atmosphere at concentration between 5 and 15 percent. Concentrations lower than 5 percent (lower explosive limit) and above 15 percent (upper explosive limit) are insufficient or too rich to support combustion, respectively. Methane is also an asphyxiant to humans and animals at high concentrations. Uncontrolled LFG can adversely impact the integrity of cover systems. If gases build-up below an impermeable geosynthetic layer and sufficient pressures develop, gas "whales" and/or "blow-outs" of the geomembrane can occur.

2.5.2. Description of Services. A passive soil-gas survey was performed at the Himco Dump Superfund Site by Quadrel Services, Inc. (QSI) in August 1995. The objective of the soil gas survey was to verify the presence of methane and to determine the annual methane generation rate. Sampling and analysis was performed in accordance with protocols established by QSI for the EMFLUX soil gas system. Refer to QSI report in Appendix B for a complete discussion on sampling and analysis methodologies and results.

Sampling points for methane were extended over approximately 45 acres. Measurements of methane were taken from 77 sampling points located on a 200 foot grid extending approximately over the limits of the landfill, excluding the construction debris area. Mapping of the actual sampling points is shown on Figure 1 of the QSI report.

2.5.3. Summary of Results. Methane concentrations were found at very consistent levels, with the average range factor for all points being 5.2 percent. Concentrations between 50 and 65 percent were found in four probes. These high detections were located in the central and western portions of the landfill. Methane generation rates were found to vary from 0.1 ng $cm^{-2} s^{-1}$ to 497 ng $cm^{-2} s^{-1}$ in 37 probe locations, most of which were within the boundaries of the landfill area. There were no traces of methane at the other 40 locations, most of which were near the perimeter or outside of the landfill. Based on this data, it was estimated that this site is producing methane at an annualized rate of 287 million cubic feet per year ($ft^3 yr^{-1}$). Figure 2 in the QSI report shows a summary of these results and Figure 3 shows methane isoplethes. As identified in Figure 3 of the QSI report, there are four main areas of major methane generation. Tabulated methane concentrations and average methane generation rates are provided in Tables 1 and 2 of the QSI report.

2.6. BORROW SOURCES.

2.6.1. General. The source of borrow material for the site is undetermined at this time and is dependent on how the PRP's decide to utilize available on-site or adjacent property material sources. Preliminary grading plans were developed utilizing on-site borrow to the greatest extent possible. As currently graded, additional off-site borrow will be required to meet material needs. Provided below is a summary of potential on-site and off-site borrow sources.

2.6.2. On-Site Borrow Sources. All areas on the site outside of the limits of the final cover north of the residential areas are potential borrow sources. These areas include the area of the "L" shaped and small pond located just west of the landfill (west borrow area) and the quarry pond and adjacent areas (north borrow area). Storm water detention ponds will be created in these borrow areas by enlarging the existing ponds (subsequently referred to as the west and north storm water detention ponds). PRP property just north of the site is also a potential source of borrow material. Material available from on-site includes most of the cover system components including select and random fill and to a limited extent topsoil. To fully develop existing material sources, the construction contractor will need to selectively excavate materials from on-site sources that meet soil requirements for the various cover system layers. Sampling conducted during previous site investigations and during pre-design indicate that soils within the limits of the site are predominantly poorly graded sands. Soil samples taken from 0 to 1 foot below ground level in the farm fields north of the site indicate that surficial soils in this area are predominantly silty to clayey sand. Laboratory test data is presented in Appendix C. The high water table at the site will require underwater excavation in order to obtain significant quantities of borrow material from on-site sources. Boring logs from the RI/FS and pre-design activities are provided in Appendix D.

2.6.3. Off-Site Borrow Sources. After the availability of suitable on-site borrow has been exhausted, commercial sources will be required. Sandy materials are readily available in the Elkhart area. Predominant clayey soils are not readily available close to the site. A list of commercial borrow sources, as of 1996, is provided in Table 2-2.

TABLE 2-2
POTENTIAL OFF-SITE BORROW SOURCES (AS OF 1996)

Company	Sand	Riprap	Clay	Topsoil
Clarko 67230 County Road 11 Nappanee, Indiana (219) 862-4323	No gravel pit but can provide materials.	No	Limited Quantities See Note 1	Limited Quantities
Elkhart County Gravel, Inc. 19242 US 6 Route 1 New Paris, Indiana (219) 831-2815	Yes	Yes Max size approx 6-inch	Limited Quantities	Limited Quantities
Fidler Inc. 1500 W. Bristol Elkhart, Indiana (219) 262-2681	Yes	No	No	No
Fidler Inc. 1700 Egbert Goshen, Indiana (219) 533-0415	Yes	Yes Max size approx 6-inch	Limited Quantities	No
Klink Trucking, Inc. 1675 Toledo Road Elkhart, Indiana (219) 293-8941	Yes	Yes Max Size approx 6-9 inch	Limited Quantities	Limited Quantities
Elkhart County Landfill 59308 City Road 7 Elkhart, Indiana (219) 522-2581	**	**	See Note 2	**

Notes:
1. Companies contacted indicated that clay and topsoil is generally not readily available in the Elkhart area. Most could obtain the material in various quantities but would require a long haul distance.
2. The County Landfill has clay but it is primarily, and potentially exclusively, for use at the landfill. A request can be made from the County Commissioners to utilize the material.

3. DESIGN REQUIREMENTS AND PROVISIONS

3.1. GENERAL. As discussed previously and reiterated in the following sections, the ROD prescribed a specific landfill cross section and components. USACE evaluated each component of the ROD cross section to determine its adequacy in fulfilling the functional intent of the ROD. Several component layers were modified to improve performance, reliability, and lower cost. These issues were presented in a report titled *Comparative Analysis of Cover System Alternatives* prepared by USACE in November 1994. This document is provided in Appendix F. A summary of ROD prescribed cover components and the final cover system components are provided in following sections.

3.1.1. ROD Prescribed Cover System . The components of the cover system as presented in the ROD are:

- 18-inch thick vegetative soil layer,
- 6-inch thick sand drainage layer,
- 40 millimeter HDPE flexible membrane liner (geomembrane), [The intent of the ROD was to specify a 40 mil thick geomembrane, a 40 millimeter geomembrane is approximately 1.5 inches thick]
- 2-foot thick low permeability clay liner,
- Soil buffer layer of variable thickness to attain State of Indiana grade requirements (4 percent minimum), and
- Installation of an active landfill gas collection system including a vapor phase carbon system to treat the off-gas from the landfill.

3.1.2. Final Cover System Components. The landfill cover system has been designed to meet requirements of Title 29, Section 2 of Indiana Administrative Code (IAC) and the intent of the ROD. In addition, USEPA's technical guidance document *Minimum Technology Guidance for Final Covers on Hazardous Waste Landfills and Surface Impoundments*, (EPA/530-SW-89-047), was also followed where applicable. The components of the cover system were modified from the ROD prescribed components by substituting a geocomposite (geonet bonded to geotextiles) for the sand drainage layer and substituting a geosynthetic clay liner for the low permeability clay layer. Cover system components were modified to provide a more effective cover system at lower cost. The noted modifications to the cover system were acceptable to USEPA and Indiana Department of Environmental Management. The final cover system for the landfill consists of the components listed below in order of placement from top to bottom. Refer to Drawing GD.01 for typical cover system details.

- Turf (Vegetative Cover),
- 6-inch thick topsoil layer,
- 18-inch thick select fill layer,
- Geocomposite,
- HDPE Geomembrane (40 mil),
- Geosynthetic clay liner (GCL),
- 12-inch thick foundation layer, and
- Regraded refuse, soil, and/or random fill.

3.1.3. Final Cover System Limits. The final cover system will be constructed to contain all landfill materials on the northern, eastern, and western portions of the site. Any materials encountered outside of the northern, eastern and western boundaries of the landfill cap will be excavated and relocated to within the limits of the cover system. Known landfill material located outside of the limits on the south side of the final cover system in the "construction debris area" will be left in place and not covered by the final landfill cap. USEPA plans to further investigate this area to determine if remedial actions are necessary. The final cover system can be extended over this area at a later date, if required. See Drawings G7.01 through G7.04 for the cover system's final grading plan.

3.1.4. Grading Requirements. The final cover system for the site has been designed to meet the requirements in 329 IAC 2-14-19 which specifies a minimum slope of 4 percent and a maximum slope of 33 percent (1V to 3H). Proposed rules (1996) in 329 IAC 10-22 have the same general requirements for the final cover system slopes. Minimum grade requirement in the IAC is consistent with the minimum grade specified in the ROD. The constructed minimum and maximum final grade of the cover system will be 4 percent and 25 percent (1V to 4H), respectively.

3.1.5. Access Roads. Access will be provided at the northeast and southeast corners of the site as shown on Drawing G5.01. From these entrances, access roads are provided to a landfill gas treatment facility and to other parts of the site. Refer to Section 3.4.1 for additional discussion on access road layout and design.

3.1.6. Site Run-On and Run-Off Control. Indiana State requirements, both existing and proposed (1996), for diversion of surface water run-on and run-off controls systems are essentially the same. The existing rule (329 IAC 2-14-11) requires that the landfill provide and maintain sedimentation and/or erosion control systems wherever necessary to minimize erosion and sedimentation of surface waters. Any permanent surface water diversion structures must be able to accommodate the 25-year precipitation event. Proposed rule 329 IAC 10-20-12 (Operational Regulations) requires permanent storm water/sedimentation basins be designed to handle, simultaneously, the run-off resulting from a 24-hour, 25-year precipitation event and any required sedimentation storage.

North and west storm water detention ponds will be created by enlarging the existing ponds located at the west and northeast sides of the site. The material obtained from these areas, referred to as the west and north borrow areas, will be used for cover system construction to the greatest extent possible. Post-closure storm water run-off from the landfill cover system will be collected in drainage ditches and in broad drainage swales and directed to these detention ponds. Site run-on from areas north of the site will be directed to the west storm water detention pond. A drainage culvert under John Weaver Boulevard directs drainage from the residential area east of the site into the existing quarry pond area (i.e. north storm water detention pond). Areas south of the site drain away from the landfill.

3.2. COVER SYSTEM COMPONENTS.

3.2.1. Vegetative Cover and Erosion Control Materials. Vegetative cover will consist of perennial cool season grasses seeded with a nurse grass after the topsoil has been placed and graded to the appropriate depth. The grass will consist of mainly K-31 tall fescue, with smaller amounts of red top and annual rye. K-31 fescue is an excellent general purpose low maintenance grass used extensively across the United States. This type of grass requires little to no fertilization or watering in this area of the country. The seed will start germinating within seven to ten days of planting. The nurse crop of annual rye of millet will start germinating within five days of seeding. A mature stand of grass should be expected in approximately 60 days.

Erosion control blankets will be used in the swales and drainage channels surrounding the landfill to prevent erosion where the flows will be concentrated. Silt fences will be placed at 100 foot intervals down the slope of the landfill to slow sheet erosion down the long slopes. Fencing will be placed parallel to the slope to prevent drainage from settling into one specific area along the fence and creating a blowout and subsequent severe gully erosion. At 50 foot intervals along the silt fence parallel to the slope, additional silt fencing will be turned up perpendicular to the slope to add reinforcing to the silt fence parallel to the slope and to segregate small portions of the drainage from forming into larger pools along the fence.

3.2.2. Topsoil. Topsoil will be placed to promote a vegetative stand that is relatively maintenance free, that readily grows in the climatic environment of the area, and which will not be easily eroded. Spreading of topsoil will be performed in such a manner that planting can proceed with little additional soil preparation or tillage. With the exception of compaction achieved due to placement and spreading equipment, topsoil will not be compacted to promote the growth of the vegetative cover. Topsoil will be uniformly distributed and evenly spread to a minimum thickness of 6 inches overlying the select fill layer. At this time, it appears that most topsoil will be obtained from off-site sources. Topsoil is not readily available from on-site sources. PRP owned property north of the landfill may provide some topsoil material if developed. On-site sources will need to be amended to provide acceptable material.

3.2.3. Select Fill. A layer of select fill will be provided immediately under the topsoil layer to support the root systems of the vegetative cover, provide water holding capacity, protect the underlying geosynthetic materials from human and animal intrusion, and from damage due to construction and maintenance equipment. The select fill layer also serves to attenuate rainfall infiltration into the underlying drainage layer. The minimum landfill cover thickness per *Minimum Technology Guidance for Final Covers on Hazardous Waste Landfills and Surface Impoundments* (EPA/530-SW-89-047) is 24 inches. This minimum soil cover thickness allows for the protection of the geosynthetic components of the cover system. A minimum cover thickness is also required for constructability purposes. The 24- inch thick cover will be composed of the 6-inch thick topsoil layer, as previously discussed, and the 18-inch thick select fill layer. These thicknesses correspond to the requirements stated in the ROD.

To accommodate locally available materials, the select fill layer will likely consist of predominantly coarse grained material (i.e., sands) with varying fractions of fines. The specifications require that select fill material be classified as silty sand (SM), Clayey sand (SC), Silty-clayey sand (SC-SM), or lean clay (CL) according to the Unified Soils Classification System. As specified, the select fill material will have a minimum fines content of 12 percent. This type of soil will have a greater water holding capacity and attenuation properties as compared to materials with little or no fines such as a well or poorly graded sand. Other materials, such as lean clays (CL) are acceptable. However, this type of soil is not readily available near the site. Use of non-plastic or low plasticity soil reduces the potential for vertical tension cracks. Highly plastic soils, such as fat clays, are not allowed due, in part to, to constructability problems and are not locally available. The maximum particle size of select fill material is specified not to exceed 0.75-inch to minimize the potential for puncture or other damage to the underlying geosynthetics.

The contractor will be required to place select fill in a manner that will not damage the underlying geosynthetics. Select fill material will be placed starting at the toe and working up and parallel to the 1V to 4H side slope. The first layer of the select fill will be placed at a minimum thickness of 15 to 18 inches to avoid damaging the underlying geotextile. Equipment will not be allowed to be driven or pulled on any of the geosynthetics during select fill placement. Select fill will not be dropped or dumped onto the geosynthetics from a height greater than 36 inches and will not be stockpiled on or pushed across the geosynthetics. Low ground pressure (LGP) equipment, such as a tracked front end loader, are specified for placement of select fill material. The ground pressure from loaded transport and placement equipment will be limited to 7 pounds per square inch (psi). To protect the geosynthetics, achieve stable slopes, and to enhance the soil's ability to support vegetative growth, the select fill will be compacted with limited effort using a specified number of passes of the placement equipment.

The preferred local source of select fill material is from PRP property north of the quarry pond. This material is located up-gradient and remote from the landfill and should be free of chemical contamination and appears suitable for placement above geosynthetic materials. Other potential on-site sources (i.e., West and North Borrow Areas) may also provide some of the required select fill material if fully developed. If the PRP chooses not to utilize on-site borrow areas, the material will need to be obtained from off-site sources. Material used for selected fill will be analyzed for chemical contamination and only "clean" material will be used. Refer to Section 3.15 for chemical testing requirements.

3.2.4. Geocomposite. Geocomposites will be utilized as the cover system's drainage layer in place of a sand drainage layer as prescribed by the ROD. A geocomposit consists of geotextiles attached to both sides of the geonet core. Geocomposites were chosen over a sand drainage layer because it was found to be less costly, easier to construct, and was more hydraulically efficient. The primary function of the geocomposite drainage layer is to intercept water that infiltrates through the topsoil and select fill layers and convey it out from the cover system. To remove the water from the cover system, the geocomposite discharges into a perimeter subdrain system that conveys the water to discharge points near the storm water detention ponds. The drainage layer has been designed to minimize the head build-up and residence time of water in contact with the geomembrane, thus decreasing the potential for infiltration and leachate generation into the waste mass. One layer of the geocomposite drainage material will be placed on the 4 percent top slopes of the cover system. Two layers of geocomposite will be utilized on the 1V to 4H side slopes and in the drainage channels to insure effective removal of water from the cover system. See Appendix A for typical design calculations.

Chemical compatibility between infiltrating surface waters and geocomposite materials is not considered a problem when utilizing a geocomposite in a cover system application. For this type of use, geocomposite materials typically only comes into contact with relatively "clean" water which have a limited potential to biologically or chemically attack or clog the geosynthetic drainage layer. Normal stresses imposed on the geocomposite from overlying select fill and topsoil, approximately 1.5 psi, are relatively light and is not a critical cover design parameter. This level of normal stress will result in limited intrusion of the geotextiles into the geonet.

The geonet core of the geocomposite will consist of a high density polyethylene drainage net. On either side of the geonet, non-woven geotextiles will be heat-bonded to the geonet core. The geotextile on the top or upper side of the geonet will function as a filter/separation layer between the select fill and the underlying geonet drainage layer. The bottom or lower geotextile provides a stable interface against the underlying geomembrane, particularly on 1V to 4H side slopes.

The geocomposite was sized to convey the design flow rate determined from the Hydrologic Evaluation of Landfill Performance (HELP) model. a complete discussion of HELP modeling is provided in Section 3.7 . The peak daily flow rate from the drainage layer was estimated at approximately 75 cubic feet per day per linear foot for a 500 foot drainage length on a 4 percent slope. Design flow was increased with partial factors of safety totalling 2.3 to account for intrusion, creep, and chemical and biological clogging. A global factor of safety of 1.0 was used because the design flow was based on the peak daily drainage flow for the longest drainage length on the cover system. The resulting minimum transmissivity of the geocomposite was determined to be 20 gallons/minute/foot. Specifications require the geocomposite to have a minimum transmissivity of 20 gallons/minute/foot under an applied normal pressure of 1.45 psi and a hydraulic gradient of 0.1.

A geotextile filter layer is provided between the geonet and select fill layer to prevent migration of fine grained soil particles into the drainage layer. The specifications require the geotextile have an apparent opening size [O_{95} or AOS] between the No. 70 and No. 100 sieve. This requirement assumes that the select fill material will have more than 50 percent fines. This is a conservative assumption since the soil used for the select fill layer will most likely be predominantly sand as discussed previously. In addition to preventing migration of fines, the geotextile must be able to pass infiltrating surface water into the underlying geonet drainage layer. The flow rate of water passing through the geotextile was estimated assuming that all water from a four inch rainfall passes through the filter over a 12 hour period. This results in a flow rate of approximately 0.03 cubic foot per hour per square foot. Assuming a negligible head of 0.01 inch, the resulting permittivity is approximately 9×10^{-6} sec^{-1}. After applying partial factors of safety totaling over 20 to account for soil clogging and binding, creep, intrusion, chemical clogging, and biological clogging and a global factor of safety of 50 to account for gross design assumptions and unknowns, the required permittivity of the geotextile was determined to be 1.0 sec^{-1}.

Geotextile physical properties were selected to insure the material will survive the construction and installation process. Physical properties of the geotextiles were generally based on the recommendations contained in the American Association of State Highway and Transportation Officials (AASHTO) specification M-288 for a separation geotextile with a "high" degree of survivability. Burst strength requirements, which are not provided in AASHTO specification M-288, are based on site specific calculations. To minimize potential construction damage, the first layer of select fill will be placed at a minimum thickness of 15 to 18 inches using low ground pressure equipment.

As discussed in Section 3.6, one potentially critical interface in a cover system with respect to slope stability is the geocomposite's geotextile to geomembrane interface. For this project, the geocomposite will be placed in the field so that a non-woven geotextile is against the geomembrane. On the 1V to 4H side slopes, the non-woven geotextile will be installed against a textured geomembrane. This combination of materials will provide a stable interface. The geocomposite will have a specified peel strength of 2 pounds per inch to preclude internal stability concerns. As noted previously, two layers of the geocomposite drainage material will be utilized on the 1V to 4H side slopes and drainage channels to insure the efficient conveyance of water out of the cover system. This is critical on the cover system side slopes which are susceptible to slope instability if water heads develop above the geomembrane.

3.2.5. Subdrain System. A subdrain system will be utilized to convey water collected in the geocomposite drainage layer out of the cover system. On the south and east side of the cover system, the subdrain system is located below and coincident with the drainage channel. On the west and north sides of the landfill, the subdrain system is located along the perimeter of the cover system. Typical subdrain system alignment, profiles, and details are shown on Drawings G7.01 through G7.04, GP.01 and GD.01, respectfully.

12-inch diameter perforated polyvinyl chloride (PVC) or HDPE pipe and gravel will be utilized to collect and drain water from the geocomposite drainage layer. As shown on the drawings, one layer of geocomposite will be located above the granular trench material and pipe to prevent migration of fines into the subdrain system. Another geocomposite layer will be placed in the bottom of the trench. Due to the shallow subdrain gradients, smooth interior wall pipe is specified to more efficiently convey water. The subdrain pipe was sized to carry the maximum peak daily flow from the geocomposite drainage layer as determined from HELP modeling. The 12-inch diameter pipe has a flow capacity of approximately 1.1 cubic feet per second (cfs) on a slope of 0.004 ft/ft. The maximum design flow is approximately 0.7 cfs. Consequently, the pipe has a factor of safety of 1.6 for flow. Additional flow capacity will be available through the granular material used to backfill the trench and geocomposites. The drainage pipes will outlet near the gabion structures at the northeast and southwest corners of the landfill and discharge into the storm water detention ponds. In-line clean-outs will be installed approximately 200 feet on-center. The outlet for the east drainage channel will be located in a new manhole constucted during the extension of the 30-inch diameter reinforced concrete pipe (RCP) to the north storm water detention pond.

3.2.6. Geomembrane. A geomembrane will serve as the primary hydraulic barrier layer to minimize long-term migration of liquids through the cover system into the underlying waste mass. The geomembrane specification requires a 40 mil HDPE as prescribed by the ROD. HDPE geomembranes are resistance to chemical attack and can accommodate relatively large differential settlements. For this site, chemical resistance is not a concern and large differential settlements are not anticipated. Consequently, HDPE is acceptable for use although it is not needed to resist chemical degradation. Both smooth and textured geomembranes will be utilized in the cover system. Smooth geomembrane is specified for the 4 percent top slopes and textured geomembrane is required for the 1Vto 4H side slopes where stability concerns are more critical.

The geomembrane will be placed within the frost zone and will consequently be subject to freeze-thaw effects. Frost depths from various sources ranged from approximately 36 to 72 inches in this area. The Elkhart Public Works and Utilities indicated that the frost depth is usually 36 to 48 inches and occasionally up to 60 inches. The Department of Public Works for the city of South Bend, Indiana noted frost depths in open areas of up to 72 inches. A Corps of Engineers guidance document (TM 5-809-1/AFM 83-3, Chap 1) states that the maximum depth of penetration is 64 inches for Fort Wayne, Indiana, which is located approximately 80 miles southeast of the site. Research conducted by the Geosynthetics Research Institute (Hsuan, Sculli, & Koerner, 1993) on the effects of freeze-thaw cycling on geomembranes produced from seven different resins (i.e., PVC, VLDPE, HDPE, PP, CSPE, EIA, and FCEA) and their seams indicate that after 50 freeze-thaw cycles the influence on sheet and seam performance is nominal.

The geomembrane has been designed so that it will not be placed in tension in the cover system. Slip joints on the landfill gas extraction wells allow for differential movement between the well and geomembrane to prevent tearing or other damage to the geomembrane. The contractor will be required to submit penetrations details for approval based on manufacturer recommendations. To confirm stability design assumptions, the specifications require a direct shear test be performed on the textured geomembrane to geosynthetic clay liner interface as discussed below.

3.2.7. Geosynthetic Clay Liner. A reinforced GCL will be installed immediately below the geomembrane to form a composite barrier system. The purpose of the GCL in a composite cover is to inhibit the movement of water which passes through defects in the geomembrane. A GCL will be used in lieu of the clay in the composite barrier system because of superior performance and lower cost as compared to a compacted clay layer. The GCL layer meets the functional intent of the ROD. Reinforced geosynthetic clay liner are factory manufactured hydraulic barriers that consist of a thin layer (approximately 1/4-inch) of bentonite clay sandwiched between two geotextiles. The geotextiles are needle-punched are stitched together to provide internal shear strength to the composite. Either woven and/or non-woven geotextiles are attached to the bentonite core depending on the product selected.

The hydraulic conductivity of a GCL typically range from $1x10^{-8}$ cm/sec to $1x10^{-10}$ cm/sec depending on material properties and confining stress. For final cover systems with a confining stress on the order of 200 pounds per square foot (psf) to 600 psf, backpressure-saturated hydraulic conductivity of test specimens of the bentonite component of GCLs were in the 10^{-9} cm/sec range (Daniel, 1993). Research performed to date indicates that the hydraulic conductivity of GCLs does not undergo large increases as a result of freeze-thaw. This is an important design consideration since the GCL will be placed within the frost zone. Available data indicate that the high shrink-swell capacity of bentonite gives the GCL the ability to self-heal if any alteration due to freeze-thaw occurs (Daniels, 1993). Bentonites shrink-swell characteristics also gives GCLs the ability to self-heal if any alteration occurs from wet-dry cycles. GCLs also have the capacity to undergo greater deformation and tensile strain without undergoing significant increases in hydraulic conductivity as compared to compacted clay liners. Deformation and the development of tensile strain can be expected to occur in any cover system to some extent due to localized differential settlements.

As specified in the ROD, the compacted clay layer would also have been located within the frost zone. The hydraulic conductivity of a compacted clay layer increases after just a few freeze-thaw cycles. As a result, instead of an as-constructed hydraulic conductivity of $1x10^{-7}$ cm/sec, the hydraulic conductivity of the clay layer can be expected to increase into the range of $1x10^{-6}$ cm/sec to $1x10^{-5}$ cm/sec as the material undergoes several freeze-thaw cycles. The hydraulic conductivity of compacted clay liners can be similarly affected by wet-dry cycles and dessication from landfill gases. Wetting and drying of compacted clay layers can cause swell and shrink and the subsequent development of desiccation cracks. These cracks may only partially close during future wet periods which results in only partial recovery of the original hydraulic conductivity.

To enhance the stability of the cover system on the 1V to 4H side slopes, a non-woven geotextile will be placed against the textured geomembrane. To insure that the materials selected by the contractor exhibit the necessary interface shear strength, direct shear testing of the GCL to textured geomembrane and GCL to slect fill interfaces are required in the specifications. Direct shear tests will be performed under hydrated conditions and under normal stresses that are representative of the final cover system. The specifications also require the geosynthetic clay liner have a minimum peel strength of 15 pounds to insure that the geotextiles are adequately bonded and provide sufficient internal reinforcement so that slope stability is not a concern with respect to internal failure of the GCL.

The GCL will be placed on a 12-inch thick foundation to separate the GCL from underlying waste and random fill. In addition to providing a suitable sugrade with respect to protrusions and particle sizes, the foundation layer will separate the GCL from the calcium sulfate waste materials. The GCL requires separation from calcium sulfate to prevent exchange of the sodium cations in the bentonite with the calcium cations in the calcium sulfate. A cation exchange of this type, if allowed to occur, would result in an increase in the permeability of the bentonite layer. A 12 inch separation between the sodium bentonite in the GCL and the waste is sufficient to minimize the potential for this to occur.

3.2.8. Foundation Fill. A minimum 12-inch thick random fill layer will separate and protect the geosynthetics from the waste and will serve as the subgrade for final cover components. The foundation fill will also serve as a landfill gas collection layer. In order to function as a gas collection layer, the foundation layer material will consist of a granular soil (i.e., sand) that meets the gradation provided in the specifications. The gradation in the specifications allows for the use on site materials, although selective excavation and utilization of borrow material by the contractor will be required. A granular material will allow the lighter than air fraction of landfill gas to migrate toward the highest point in the cover system with the least amount of resistance. Foundation fill material will be compacted to a minimum relative density of 85 percent. All foundation fill material will be drained prior to placement to minimize the potential production of leachate and/or contaminated surface runoff and to limit the moisture available to the GCL to minimize hydration of the bentonite. The material will be dried to the point where water does not drain from the material during placement. A maximum particle size of 0.5 inches will minimize the potential of puncturing the GCL and overlying geosynthetics.

3.2.9. Random Fill. After clearing, grubbing, required excavation, and proof rolling, random fill will be placed to achieve the grades required for the final layers of the cover system. Random fill will be either cohesive or non-cohesive suitable material. It is anticipated that the material will be obtained from on-site borrow sources which contain predominantly non-cohesive soils. However, the actual source of borrow materials will be determined by the PRP's. The first lift of random fill will not be subject to specific density requirements because of the difficulty in achieving a specified density on top of landfill materials. In lieu of having specific density requirements, the random fill will receive a procedural compactive effort of three passes of the compaction equipment. All other lifts of random fill will be compacted to specific density requirements. If the random fill material is cohesive, the fill will be compacted to at least 90 percent of the maximum density as determined by the Standard Proctor method. If the random fill material is cohesionless, the fill will be compacted to a minimum relative density of 85 percent. All non-cohesive fill material will be drained prior to placement to minimize the potential production of leachate and/or contaminated surface runoff. The material will be dried to the point where water does not drain from the material during placement.

3.2.10. **Regrading Landfill Material.** Landfill material will be excavated and regraded to minimize random fill requirements, to avoid impacting adjacent properties and to limit the final cover side slopes to a grade no greater than 1V to 4H. In addition, landfill material located outside of the north, east and west boundaries of the final cover system will be excavated and relocated to within the limits of the cap. As discussed previously, landfill material consists predominantly of construction debris and calcium sulfate. Areas excavated outside of the limits of the cap to remove waste will be backfilled with random fill to grade. Known landfill material is located outside of the limits of the final cover along the southern side of the final cover in the construction debris area as previously noted. This material will be left in place as directed by USEPA. During regrading operations, potentially contaminated surface run-off from exposed waste will be controlled utilizing temporary and discrete collection and detention facilities. The contractor will develop stormwater control measures based on planned construction operations and sequencing. Potentially contaminated water collected prior to completion of the foundation layer will be applied to the random fill and allowed to infiltrate into the waste mass. Contaminated water collected after completion of the foundation layer will be disposed of off-site. Approximately 82,000 cubic yards of landfill material and soil within the limits of the landfill boundaries will be excavated and regraded.

3.2.11. **Inspection Trench.** During initial excavation and regrading operations, the contractor will be required to construct an inspection trench around the entire perimeter of the final cover system. The inspection trench will follow the alignment of the cover system subdrain trench and drainage ditches. As noted above, any landfill material located outside of the northern, eastern, and western section of the trench will be relocated under the final cover system. The cover system grading plan allows for the placement of approximately 122,000 cubic yards of unidentified material such as additional waste, cleared and grubbed debris, daily cover (This volume is in addition to the 82,000 cubic yards of known landfill material and soil to be relocated as noted in the previous section.). If encountered, this additional waste material would be used in place of the random fill.

3.3. LANDFILL GAS COLLECTION AND TREATMENT SYSTEM.

3.3.1. **General.** The ROD requires the installation of an active landfill gas collection and treatment system. The purpose of the LFG collection and removal system is to provide effective LFG migration control and to prevent physical disruption of the landfill cover components. Gas collection involves capturing the LFG that is naturally produced due to the decomposition of organic material disposed of at this site. LFG typically has a composition of 40 to 60 percent methane (CH_4) and 40 to 50 percent carbon dioxide (CO_2). Trace amounts of oxygen (O_2), nonmethane organic compounds (NMOC) whose principal components are hydrogen sulfide (H_2S), and reactive organic gases (ROGs), may also be present in LFG. LFG at this site will be collected by both vertical extraction wells and horizontal extraction trenches as shown on Drawings G8.01 and G8.02. Collected LFG will be treated to remove volatile organic compounds by granular activated carbon units and combusted with a flare. The perimeter of the site will be monitored for off-site methane migration by 18 LFG monitoring probes as shown on Drawing G8.04.

3.3.2. Landfill Gas Migration. There are two mechanisms by which gases migrate through refuse or soils; convection and diffusion. Convection occurs where there is a differential gas pressure within the system. Flow by convention occurs from zones of high pressure to zones of low pressure. Diffusion is the flow of gas as a result of differential concentrations. Gases tend to move from zones of higher concentration to zones of lower concentration. Vertical or lateral migration paths for landfill gas movement are influenced by the final cover system and the presence of migration corridors and/or barriers. Migration corridors include sand and gravel lenses, void spaces, cracks, and fissures. Barriers to gas migration include the geomembrane and high or perched water tables. Saturated or frozen layers promote lateral migration of landfill gases.

3.3.3. Landfill Gas Distibution and Emission Rates. As discussed previously, a passive soil gas survey was performed by Quadrel Services Inc., in August of 1995. The survey found varying concentrations of methane around the site with the concentration exceeding 50 percent in several areas. The highest methane producing regions were located in the western and north central portions of the landfill. One other high methane producing area was located near the southeast corner of the landfill. Consistent emission levels typically indicate areas currently producing methane. Methane generation rates over the site were found to be anywhere from 0.1 ng $cm^{-2} s^{-1}$ to 497 ng $cm^{-2} s^{-1}$. Based on this data, it was estimated that this site is producing methane at an annualized rate of 287 million ft^3/year. The concentration and volume of methane generated by the landfill confirmed the need for a landfill gas collection and treatment system as prescribed in the ROD.

3.3.4. Landfill Gas Collection System. The LFG collection system will consist of nine extraction wells and two shallow extraction trenches. As discussed in the following sections, the wells and trenches are located near the crest and near the perimeter of the cover system, respectively.

3.3.4.1. Landfill Gas Extraction Well Design. Nine LFG extraction wells will be located near the high point of the final cover system on pads constructed adjacent to the cap access road. The wells will extend into a locking protective casings and vaults finished flush with the final grade as shown on Drawing GD.02. The vault will be surrounded by three bollards. Installing the well heads below grade in the locking vaults will minimize the potential for damage from vandalism or other unauthorized tampering. Extraction wells will penetrate into the landfill materials to an elevation of approximately 760 ft msl. The bottom of the extraction wells were set at the noted elevation to reduce the potential to draw groundwater into the wells and thereby minimize the amount of condensate that will need to be treated. The bottom of the wells are approximately five feet above the highest groundwater level recorded in 1996. In September of 1996, groundwater varied from approximately elevation 752 to 755 ft msl across the site.

The extraction wells will consist of Schedule 80 PVC casing and screen. The casing will have a nominal diameter of 6-inches and the screen will have a nominal diameter of 8-inches. A slip coupling will connect the smaller diameter casing to the screened section to allow for settlement of the well without damaging the geosynthetics. Extraction wells will be connected to a 6-inch diameter lateral which connects to the header pipe. Flexible connections will be used at various locations between the well and header pipe to accommodate differential settlement. A "tee" fitting with removable airtight cap will connect the well to the lateral. This type of fitting will allow for inspection of the well and passive venting during consruction and post-closure should the collection system fail. Each extraction well will be fitted with a gas sampling port, a valve to regulate flow rates, a flow meter, and hosing for vacuum gages. One set of readout gages will be supplied by the contractor.

The pipe sizes will accommodate the anticipated airflow and minimize head losses. The screens for the trenches and wells will have 0.25-inch wide by 6-inch long slots staggered 45 degrees every 6-inch length of pipe. Screens will be slotted at the manufacturer to preclude field fabrication. This type of screen will have a large open area to allow for gas flow and minimize head losses across the perforations. The gravel pack surrounding the screened interval will consist of clean, washed, sands and gravels which do not contain calcareous materials. Calcareous materials, such as limestone, may be susceptible to dissolution due to potential low pH conditions in landfill material. The gravel pack gradation, AASHTO No. 57 (M43), was selected to allow for an extremely permeable media surrounding the screen. PVC was selected as the piping material to accommodate stresses and temperatures within the waste mass and is commonly used for this type of application.

3.3.4.2. Landfill Gas Well Spacing. The extraction wells are spaced approximately 200 feet on-center along the high point of the final cover system adjacent to the cap access road. Extraction rates for the LFG extraction wells were determined assuming the wells will have a radius of influence of approximately 125 feet. Based on a theoretical radius of influence of 125 feet and other assumptions, the wells will draw gas at a rate of approximately 560 cubic feet per minute (cfm). This is about half of the estimated 1,100 cfm of gas produced by the landfill. In actuality however, the extraction wells will be drawing gas from a much larger distance than the assumed radius of influence.

As discussed previously, the foundation layer will also serve as a gas collection layer. The lighter than air fraction of landfill gas that enter the foundation layer and that is not captured by the extraction trenches will migrate to the crest of the cap where the extraction wells are located. The wells have the capacity to remove any gas that migrates to the landfill's crest via the foundation layer. In addition, shallow extraction trenches will capture gases in other areas of the landfill as discussed in the following section. The wells, in combination with the extraction trenches, provide coverage over all methane producing regions of the landfill.

3.3.4.3. **Landfill Gas Extraction Trench Design.** Extraction trenches will be utilized around the perimeter of the landfill to prevent lateral migration of gases. Trenches are used instead of wells in these areas due to the limited waste mass thickness and shallow depth to groundwater. The extraction trenches will extend approximately five feet below the bottom of the foundation layer and will have a minimum width of 24 inches as shown on Drawing GD.03. Each extraction trench system will consist of a header that is connected to several screened sections that are independently valved and metered. Each header can be controlled at the treatment facility. The extraction trench and well collection system allows for operational modifications over the post-closure period so that methane producing regions can be specifically targeted and system efficiency maximized.

The screens for the trenches will have 0.25-inch wide by 6-inch long slots staggered 45 degrees every 6-inch length of pipe. Screens will be slotted at the manufacturer to preclude field fabrication. The screen sections will be connected to 10-inch diameter headers through a 6-inch diameter lateral. Each screened section valve, sampling ports, etc will be located in an HDPE manhole located on the lateral.

3.3.4.4. **Header Pipes.** Three HDPE header pipes will run to the treatment facility, two from the LFG extraction trenches and one from the LFG extraction well system. As noted above, the header pipe for the trenches will have a diameter of 10 inches and the well header will have a diameter of 12 inches. Header pipes were sized to minimize head losses and to provide additional capacity, should supplementary extraction wells or trenches be required during the post-closure period. The well header is located above the geosynthetic layers along the centerline of the cap access road. Placement of header above the geosynthetics allows for future maintenance or expansion of the system if required. The well header pipes will be placed at minimum 1 percent slopes with the high points located midway between extraction wells. This will allow condensate in the pipes to flow back to the wells to minimize the potential for pipe blockage. A series of settlement gages are located along the crest to monitor the change in slope of the pipe over time.

The majority of the trench headers will be located below the geosynthetic layers in order to be placed below frost depth. Similar to the well header, the trench header will be placed at minimun one percent slopes with the high points located midway between extraction trench wellheads. This will allow condensate in the pipes to flow back to the wells to minimize the potential for pipe blockage.

Header pipes will be placed on a minimum bedding of 6 inches and will have a minimum granular cover of 6 inches. The trench and well headers converge under the cover system access road and extend to the treatment facility in the same trench along the access road alignment. Header pipe inverts under the access road are located five feet below the final grade to account for frost. At the treatment facility, a sampling port, vacuum gage, and control valve is provided on each header.

3.3.5. Landfill Gas Treatment System. Gases and condensate collected in the LFG collection system will be treated prior to disposal at an on-site treatment facility. A discussion of the treatment system is provided in the following sections. Design calculations are provided in Appendices G, I, and J.

3.3.5.1. Treatment and Disposal of Condensate. Condensate will be treated using liquid-phase granular activated carbon (LGAC) units (lead and lag units) prior to draining into a double walled underground storage tank for temporary storage. The condensate flow rate was estimated to be approximately 600 gallons per day or less than 1 gallon per minute (gpm). The size of the LGAC unit will depend on this flow rate (used 1 gpm). The required retention time inside the LGAC unit is 8-10 minutes. Using a low-flow (10 gpm) LGAC unit, this can be achieved with flow rates up to 5 gpm. With utilization of a 10 gpm LGAC unit, the retention time (contact time) will be higher than 10 minutes since the condensate flow rate is estimated to be under 1 gpm.

Landfill off gas includes VOCs such as methyl chloride, vinyl chloride, methylene chloride, acetone, carbon disulfide, 1,1-Dichloroethylene,1,1-Dichloroethane, 1,2-Dichloroethene (total), 1,1,1-Trichloroethane, trichloroethene, benzene, tetrachloroethene, toluene, ethyl benzene, styrene, and xylenes (refer to Table 1 in Appendix G, Environmental Calculations, for concentrations). These VOCs may also be found in the condensate. However, concentrations of these VOCs in the condensate are not known. Since condensate VOCs concentrations are not known, an estimate was not made to determine the approximate carbon usage. However, a low-flow (10 gpm) LGAC unit may be effective especially in removing those VOCs with relatively high molecular weight. The VOCs with low molecular weight, such as methyl chloride, vinyl chloride, methylene, chloride, acetone, carbon disulfide, and 1,1-Dichloroethylene may not be effectively removed and may pass through the carbon. The LGAC unit will be put on-line to achieve the effluent VOCs concentrations that are below the local Public Owned Treatment Works (POTW) discharge limits (refer to Section \-01402-\: Chemical Quality Management for acceptance limits on the VOCs in the influent). The Contractor will coordinate the sanitary sewer discharge with Elkhart Public Works and Utilities.

Condensate will be periodically sampled at the influent and effluent ports and analyzed for the parameters according to Section 01402: Chemical Quality Management to determine when to replace the spent carbon. Each LGAC unit will have a capacity to last a minimum of 30 days. In addition, the condensate that has accumulated in the underground storage tank will also be tested prior to discharge into the POTW. If the condensate does not meet the discharge limits set by the local POTW, then it will be transported to a State-approved Treatment Storage and Disposal (TSD) facility for treatment and disposal.

3.3.5.2. **Landfill Off Gas Treatment.** A total of four (4) vapor-phase granular activated carbon (VGAC) units will be used to treat the off gas. Two VGAC units operating in parallel and located after each blower will be used to treat the landfill off gas primarily for hydrogen sulfide. Some of the VOCs listed previously (especially those with relatively high molecular weight) may also be captured in the VGAC units. The temperature of the gas entering into the VGAC units will be kept at 135°F or below through heat exchangers located before the VGAC units. The flow rate per unit is estimated to be approximately 275 cfm (total flow rate for the total of 4 VGAC units will be (estimated) 1,100 cfs.) There will not be any back-up units and the units that would be in operation will be periodically monitored to replace the carbon at breakthrough. Each VGAC unit will have a capacity to last a minimum of 30 days.

A pilot test (specified in spec section 11241) will be conducted prior to installation of the VGAC units to determine actual carbon usage. This will be done by using a 55-gallon VGAC unit and a 100 cfm off gas flow rate and continued until the hydrogen sulfide breakthrough is reached which will be determined upon detection of H_2S by a H_2S detection (monitoring) equipment. Discharge of total VOCs into the air is anticipated to be below the State's discharge limits (based on the reaults of the soil gas sampling effort conducted during the remedial investigation activities on site. The State indicated a total VOC limit of 15 lbs emitted per day or 25 tons emitted per year (based on a telephone conversation with Mr. Don Poole, Air Management, Indiana Department of Environmental Management, on 29 November 1995). The VGAC units will be periodically sampled for hydrogen sulfide at the influent and effluent ports and analyzed according to Section \-01402-\: Chemical Quality Management to monitor the compliance and determine when the spent carbon needs to be replaced.

3.3.5.3. **Flare.** A flare system will be utilized after the off-gas and condensate treatments to combust methane. The flare will be of the enclosed type, rated for a landfill gas flow rate of between 200 and 1100 cfm. The rate at which the flare is burned will be determined during the system startup and balancing period. The expected life of the flare is 7 to 10 years. The stack will be lined with a modular type ceramic fiber refractory material design to keep the stack skin temperature below 200 degrees Fahrenheit. The 110 volt/propane intermittent pilot system will provide automatic pilot/relight. Propane fuel storage will be provided by a primary and a back-up tank, each having a capacity of five gallons. The contract specifications will limit the noise the flare can emit since inhabited dwellings are nearby. Noise from the flare will be specified to be less than or equal to 80 decibels at 20 feet from the flare.

3.3.5.4. Blowers and Aftercoolers. Two electric motor powered regenerative type blowers will be used to deliver the landfill gas from the landfill to the flare. The blowers will be sized to deliver 550 cfm each for a total of 1,100 cfm. Two air-cooled aftercoolers will cool the landfill gas to between 70 and 135 deg F to allow the use of vapor phase carbon absorbers.

3.3.5.5. Landfill Gas Piping System. The piping in the vicinity of the blower and flare will be 8-inch diameter or smaller, fusion welded polyethylene. Coated steel moisture separators will be included for condensate removal. All above ground piping will have aluminum jacketed thermal insulation.

3.3.5.6. Condensate Removal System. The condensate removal system will consist of condensate drains from the moisture separators. Each drain line will be protected from freezing with electrical heat tape to frost depth. The drains will feed into a header which will empty into an underground condensate storage tank. The piping for the drains and header will be of polyethylene. The double walled condensate storage tank will be of fiberglass and have a capacity of 15,000 gallons. Condensate will be removed on an "as needed" basis by a pumping truck and taken to a POTW. It is anticipated that condensate will need to be removed on a monthly basis.

3.4. OTHER DESIGN FEATURES.

3.4.1. Access Roads. Access will be provided at the northeast and southeast corners of the site as shown on Drawing G5.01. From these entrances, access roads are provided to a landfill gas treatment facility and to other parts of the site. The north entrance and road (Access road "A") allow heavy vehicle direct access to the landfill gas treatment facility without having to travel on access roads over the landfill cover system. This road also provides access to upgradient monitoring wells. The next segment of access road, access road "B", extends from the treatment facility to the southeast entrance. This road provides access onto the cover system to landfill gas extraction wells and settlement gages. Two additional roads, access roads "C" and "D", are provided along the southern and eastern sides of the landfill cover system to facilitate inspections of the site and to provide access to landfill gas monitoring probes and groundwater monitoring wells. Permits and approval for constructing the new access roads will be required from the city and county. Refer to Appendix A for design criteria.

A turnout from Access Road "A" onto John Weaver Parkway will be paved with bituminous pavement. The remainder of the road will be paved with an aggregate surface course. The asphalt road cross section will consist of a 2.5-inch thick bituminous pavement, a 6-inch thick aggregate base course, a 6-inch thick subbase course, and a compacted subgrade. The remainder of the road will consist of an 8-inch thick aggregate surface course over a compacted subgrade.

A turnout from Access Road "B" onto County Road 10 will also be paved with bituminous pavement. The remainder of Access Roads "B", "C" and "D" will be paved with an aggregate surface course. The asphalt road cross section will consist of a 2.5-inch thick bituminous pavement, a 6-inch thick aggregate base course, a 5-inch thick subbase course, and a compacted subgrade. The remainder of the road will consist of a 6-inch thick aggregate surface course over a compacted subgrade.

3.4.2. Fencing. New FE-6 type chainlink security fence will be used to provide a boundary for the site and as a security fence around the LFG treatment facility. The fence will have a standard single outrigger with three strands of barbed-wire on the outrigger. Seven foot high fabric and top rail and bottom tension wire will be provided. Chainlink fabric will be zinc or aluminum coated 9-gage wire woven in a 2-inch mesh. Tie wires will be 9-gage galvanized steel wire.

3.4.3. LFG Treatment Facility Structure. The roof structure over the LFG treatment equipment consists of a metal deck supported on steel joists welded to steel columns. The metal deck is designed to support snow loads and construction loads, and to act as a diaphragm to transfer lateral wind loads to the joists on column lines. The joists and columns are designed to form rigid frames to resist wind loads. Concrete foundations provide stability against uplift and overturning forces. Refer to Appendix I for design calculations.

3.4.3.1. Design Loads and Conditions.

3.4.3.1.1. Roof Live Loads. The roof snow load was determined in accordance with American Socitey of Civil Engineers (ASCE) publication 7-93. Ground snow load used in determining the roof snow load is 20 psf. Other factors used in design are: Ce (Exposure Factor) = 1.0, Ct (Thermal Factor) = 1.2, I (Snow Load Importance Factor) = 0.8. A minimum roof live load of 20 psf was used for construction and maintenance loads.

3.4.3.1.2. Wind Loads. External design wind pressures were computed in accordance with ASCE 7-93 using a 50-year basic wind speed of 80 mph. Other factors used in determining the wind pressures are: I (Wind Load Importance Factor) = 1.0, GCpi (Internal Pressure Coefficient and Gust Response Factor Product) = 0.80 for positive pressure on the underside of roof overhangs.

3.4.3.1.3. Seismic Loads. Seismic loads were computed in accordance with ASCE 7-93. Forces due to seismic accelerations are less than wind design loads.

3.4.3.2. **Foundation Design Criteria.** The following parameters were used for design of the foundation:

- Design frost depth = 4.5 feet below finish grade.
- Allowable excess soil bearing pressure = 1,500 psf.
- Lateral earth pressure coefficients: Ka = 0.33, Kp = 2.70

3.4.3.3. **Material Strengths.** Structural materials of the strengths indicated were used for design:

- Concrete: f'c = 3,000 psi.
- Reinforcing Steel: American Society for Testing and Materials (ASTM) A615 Grade 60.
- Structural Steel: ASTM A 36.
- Steel Joists: Steel Joist Institute Specifications.

3.4.4. **Electrical.**

3.4.4.1. **General.** The electrical design includes provisions to comply with the National Electrical Code (NEC) for Class I, Division 1 and 2 hazardous locations, due to the methane gas. Transformer rating and panelboard schedules are based on the load calculations from the Distribution Analysis for Power Planning, Evaluation and Reporting (DAPPER) computer program (which is copyright by SKM System Analysis, Inc). Refer to Appendix K for design calculations.

Prior to construction, the construction contractor will verify utility locations. If required, the power line relocations and removals will be accomplished by the local electric company. The contractor will arrange for the timely relocations and removals.

3.4.4.2. **LFG Collection and Treatment System.** Overhead electric power will be installed by the electric company at the direction of the Contractor. The Contractor will provide and install a 150 kVA padmounted transformer and extend power to the panelboard MDP at the flare station equipment pad. The utility will connect their line to the new transformer and install a new watthour meter. Panelboards MDP and RCP will be in NEMA 4 enclosure (weatherproof) and will feed all equipment, lights, and receptacles. Process area lighting will have be switched from the panelboard circuit breakers. Two flood lights (one on each end of the process area) will be photocell control with manual override from the panelboard circuit breakers.

3.4.5. **Disposal of Groundwater Encountered During Construction.** Groundwater that may be encountered during construction activities will be land applied in accordance with specification section \=01570=\: Disposal of Water. A National Pollutant Discharge Elimination System (NPDES) permit pursuant to the Clean Water Act will not be required for land application within the site limits (refer to the Appendix G attached memorandum regarding NPDES Storm Water Discharge Permit Regulations). Land application will be performed within the limits of the cover system below the foundation layer by discharging groundwater at a rate which will allow it to percolate into the soil. No sheeting action, soil erosion, or discharge into any waterways will occur. The land application will be done entirely within the limits of the final cover system.

3.4.6. Disposal of Decontamination Water. All collected (by means of containerizing) decontamination waste water will be disposed under the foundation layer of the landfill cover system. All waste water collected after the placement of the foundation fill layer will be disposed of off site in accordance with applicable Federal and State as well as local regulations.

3.5. Settlement Analysis.

3.5.1. General. A settlement analysis was performed to evaluate consolidation of waste and soil materials and the subsequent impact on cover system design. The major mechanisms of refuse settlement are:

- Mechanical consolidation or void ratio reduction by distortions, bending, crushing, and material reorientation,
- Raveling or the movement of fines into large voids,
- Physical-chemical changes from corrosion, oxidation and combustion, and
- Bio-chemical decomposition from fermentation and decay.

There are several factors that affect the magnitude and rate of settlement and are often influenced by each other. These factors include:

- Refuse type or characterization (e.g., construction debris versus municipal wastes),
- Refuse density and void ratio,
- Content of decomposable materials,
- Waste fill depths,
- Imposed stresses,
- Stress history (landfill operational history), and
- Environmental factors such as moisture content, temperature, and gases present.

3.5.2. Methods and Results. Little if any settlement is anticipated around the perimeter of the landfill because most of these areas will be regraded to remove waste and will be capped with a limited thickness of cover soils. The majority of the settlement will occur along the ridge of the cap where the existing waste layer is anticipated to be the thickest and the most new fill materials will be placed. For this reason, total long term settlement of the cover system was calculated at selected locations along the crest of the cap. The maximum thicknesses of cover materials, random fill and regraded refuse, and existing waste were assumed to be 5.5 feet, 13 feet, and 15 feet, respectively. The sand foundation will undergo instantaneous consolidation with increased stress. Consequently, long term settlement of the foundation soils was not considered.

Two procedures were utilized to estimate the settlement of the landfill cover system; a method presented by George F. Sowers in his paper *Settlement of Waste Disposal Fills*, dated 1973, from Proceedings, Eighth International

Conference on Soil Mechanics and Foundation Engineering, Moscow, [Former] USSR and a method presented by Edil, Ranquette, and Wuellner in their paper *Settlement of Municipal Refuse* compiled in Geotechnics of Waste Fills. Typical calculations are presented in Appendix A.

Sower's method utilizes traditional settlement calculation procedures and waste properties in place of soil properties. For the analyses, compressibility properties were selected that reflected a low organic content and conditions unfavorable for decay. These were chosen to correspond to the large amount of sand, construction debris, and calcium sulfate and limited amount of municipal refuse in the landfill material. These properties were also selected to reflect the age of the waste. The majority of primary consolidation of the construction debris/sand landfill material and random fill will occur during fill placement and little if any additional mechanical settlement is anticipated. For other wastes streams present, including the municipal waste and the calcium sulfate, the consolidation of the waste due to the placement of the landfill cover materials, will occur rapidly and is complete in essentially one to two months after placement. For these reasons, the primary settlement that occurs after construction was estimated to be 10 percent of the total primary settlement. Total post construction settlement, both primary and secondary, along the crest of the cap was estimated to range from 4 to 6.5 inches using Sower's method.

Edil, Ranquette, and Wuellner present a method for estimated secondary compression of waste using a model originally developed for estimating the settlement of peats. Compressibility properties were selected from a limited list of empirical parameters presented in the paper. Total settlement calculations based on this model compared well with the results from the previous analysis.

3.5.3. Conclusions. Settlement analyses of waste fills provide only an approximation of the long term settlement of the cover system. Actual versus theoretical settlement can vary significantly due to the difficulty in determining appropriate engineering properties for the waste, the inhomogeneity of the waste, and the limited knowledge of the distribution and thickness of waste materials. For this site, the results of the settlement analysis indicates that only limited post construction total or differential settlement is expected due to the age and composition of the landfill materials. Alteration of design grades will be minimal and will not affect post-closure surface or subsurface drainage.

3.6. STABILITY ANALYSIS. Static stability of the cover system veneer was evaluated using conventional infinite slope methods for no seepage and seepage conditions. In addition, the stability of the cover system was analyzed using limit equilibrium methods that considers toe buttressing as described in *Stability and Tension Considerations Regarding Cover Soils on Geomembrane Lined Slopes* (Koerner, 1993) and *Stability of Geosynthetic-Soil Layered Systems on Slopes* (Giroud, et. al., 1995).

According to *RCRA Subtitle D Seismic Design Guidance for Municipal Solid Waste Landfill Facilities* (USEPA 1995), the Himco Dump Superfund Site is not located within a seismic impact zone. A seismic impact zone is defined as an area having a 10 percent or greater probability that the peak horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravational pull (g), will exceed 0.10 g in 250 years. There is no similar RCRA Subtitle C seismic design guidance or regulation. Based on this data, the site is not located in a seimically active area and a seismic analysis was not performed.

Veneer stability of a cover system is governed by the weakest material or interface. Typically, the weakest interface (i.e., the interface with the lowest shear strength) includes at least one geosynthetic material. The cover system for this project consists of several interfaces which include geosynthetics. These interfaces are the select fill to geocomposite, geocomposite to geomembrane, geomembrane to GCL, and GCL to foundation layer interfaces. As discussed previously, the geocomposite consists of two non-woven geotextiles bonded to a geonet core. Consequently, geocomposite interfaces will have non-woven geotextiles in contact with select fill and geomembrane. Similarly, the non-woven geotextile side of the GCL is specified to be placed against geomembrane. The other side of the GCL, which can be either a woven or non-woven geotextile, will be placed against the foundation layer. Non-woven goetextiles generally have superior interface shear strength charecteristics as compared to woven geotextiles and will be utilized to increase the stability of the cover system. Textured geomembrane, which has superior interface shear strength charecteristics as compared to smooth geomemebrane, will be placed on the 1V to 4H side slopes and a short distance up the 4 percent top cap to enhance cover system veneer stability. Internal strength of the reinforced GCL and geocomposite also require consideration. To insure that these products are adequately reinforced or bonded so that internal shear strength is not the weakest plane, specifications require the GCL and geocomposite to have peel strengths of 15 pounds (ASTM D4632) and 2 pounds per inch (ASTM D413), repsectively. Based on the material requirements and limited loads imposed by the cover system soils, the internal shear strength of the GCL is not considered critical to stability. Simalarly, the internal shear strength of the geocomposite is not considered critical to stability based on required material properties.

The 1V to 4H side slopes are the most critical with respect to slope stability and the textured geomembrane to GCL and GCL to select fill are the most likely critical interfaces in the cover system. Most of the 1V on 4H slopes have a length of less than 40 feet. The longest 1V to 4H slope is located on the east central side of the cover system and has a slope length of length of approximately 70 feet and a hieght of approximately 17 feet. As designed and with a specified minimum assumed interface friction angle of 18 degrees, the cover system on the 1V to 4H side slopeshas a minimum factor of safety of 1.3 for a no seepage condition utilizing an infinite slope analysis. Seepage forces, if allowed to develop, will result in a decrease in the factor of safety. To preclude this from occurring, the geocomposite drainage layer was designed to accommodate all inflow to prevent the buildup of water above the geomembrane into the select fill layer. In addition, a double layer of geocomposite will be utilized on the 1V to 4H side slopes to insure the effecient conveyance of water to the subdrain system. If toe buttressing effects are considered, the factor of safety of the 1V to 4H cover system side slopes is approximately 1.4. The analyses assume that the geosynthetic components will not be in tension and adhesion and cohesion are neglected. The factors of safety against sliding on the 1V to 4H slopes exceed the recommended minimum value of factor of safety of 1.25 for slope stability analysis as outlined in *Guide to Technical Resources for the Design of Land Disposal Facilities*, (EPA/625/6-85/018).

The stability of the top slope of the cover system is not as critical due to the minimal 4 percent grade. A smooth geoembrane will be utilized on the top slope because interface shear strength is not as critical. Assuming the critical interface in the top slope has a friction angle of 7 degrees, which is representative of a hydrated bentonite, the resulting factors of safety is approximately 3.0 for the no seepage condition utilizing an infinite slope analysis. This indicates that only a minimal interface friction angle, which is readily attainable with the selected materials, is required on the 4 percent slopes to maintain the stability of the cover system.

Confirmatory direct shear testing of the GCL to textured geoembrane and GCL to foundation fill interfaces will be performed prior to construction as required in the specifications. Testing will be performed under conditions that are representative of field conditions.

3.7. HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE MODELING.

3.7.1. General. The Hydrologic Evaluation of Landfill Performance model was used to evaluate the overall performance of the cover system and its individual components. HELP models the hydrologic processes occurring in the landfill system including surface runoff, infiltration, percolation, evapotranspiration, soil moisture storage, surface storage, lateral subsurface drainage, snowmelt, vegetative growth, and leachate production. The HELP model requires three general types of input data: climatological, geometric, and soil characteristics. These are discussed in the following sections.

3.7.2. Climatologic Data. Evapotranspiration, precipitation, temperature, and solar radiation climatological data are required model input parameters. Base climatological data used in the model were obtained from *Climates of the States*, published by the National Oceanic and Atmospheric Administration (NOAA). Thirty-year monthly mean temperatures and rainfalls recorded at the South Bend, Indiana weather station, between 1951 and 1980 were utilized for modeling. South Bend is located approximately 30 miles west of the site. The HELP model synthetically generated daily precipitation and temperature values for this landfill for a 30-year period based on manually input data and the modeling parameters for the city of Fort Wayne, Indiana which is located 80 miles southeast of the site. Fort Wayne was used because it is the closest city to the site that is available in the HELP model.

3.7.3. Cover System Model. Five layers were used to represent the cover system in the HELP Model. In the model, Layers 1 and 2 were defined as vertical percolation layers, Layer 3 as a lateral drainage layer, Layer 4 as a geomembrane liner, and layer 5 as a soil barrier layer. The uppermost layer, Layer 1, the topsoil layer, was modeled using the programs default values for a sandy silt. Layer 2, the select fill layer, was modeled using the programs default values for a poorly graded sand. The hydraulic conductivity of this layer was varied from 10^{-3} cm/sec to 10^{-2} cm/sec to model potential material properties in order to determine the effect on the head buildup in the drainage net. The hydraulic conductivity of the on-site sandy material ranged from 10^{-4} cm/sec to 10^{-2} cm/sec as determined using Hazen's equation. However, the predominant hydraulic conductivity was of the 10^{-2} cm/sec magnitude. Layer 3, the geonet drainage layer, was modeled using the programs default values for a drainage net with the exception of in-plane hydraulic conductivity. The in-plane hydraulic conductivity of this layer was modeled to meet the requirements in the specifications. Layer 4, the geomembrane, was modeled using the programs default values for a geomembrane with a hydraulic conductivity of 10^{-11} cm/sec. The geomembrane was specified to have a total of 7 defects (holes) per acre to account for installation and manufacturing imperfections and a good placement quality. Layer 5, the geosynthetic clay layer was modeled using the programs default values for a bentonite mat. The hydraulic conductivity of the bentonite mat was 10^{-10}cm/sec. The program initialized the starting water content of the soils for the 30-year period modeled.

3.7.4. Drainage Layer Modeling. The HELP model was used to determine the peak daily maximum flow rate and head in the drainage layer. To determine the maximum flow rate, the drainage layer geocomposite (i.e., geonet for modeling purposes) was determined by assigning the highest transmissivity values available. The geocomposite was then sized to accommodate the peak daily flow utilizing partial factors of safety to account for intrusion of adjacent geosynthetics into the geonet core space, for creep deformation of the geonet, for chemical clogging, and for biological clogging. The peak daily drainage from the geocomposite was estimated at approximately 75 cubic feet per day per linear foot for the maximum drainage length of 500 feet on a 4 percent slope. A slope of 3.85 percent was also modeled to account for possible future settlement. There was no change in maximum head or flow rate with the slight reduction in slope. The peak daily head in the drainage net is less than 0.2 inches. The transmissivity of the geonet is specified as 20 gallons/minute/foot under an applied normal pressure of 1.45 psi and a hydraulic gradient of 0.1.

3.7.5. Cover System Effectiveness. Results from HELP modeling indicates that only 0.0006 percent of the total precipitation will infiltrate through the cover system and into the landfill waste. Based on these results, the cover system is extremely effective in preventing water infiltration into the waste mass.

3.8. HYDROLOGIC DESIGN.

3.8.1. General. In order to design the landfill cover sytem, drainage ditches and culverts, and to lay out the site drainage, it was necessary to analyze site rainfall and runoff. The Corp's Hydrologic Engineering Center's HEC-1 Model was used. Discharge values computed using the HEC-1 model were spot checked using USGS Regional equations and the Rational Method.

The Himco Dump Superfund Site is located on the northwest edge of Elkhart, Indiana, in an area of wetlands and woods north of the St. Joseph River. The natural surface drainage for the site is towards the Manning Ditch, located roughly 0.5 miles west, through a swale and a wetland. Some drainage enters the site from "upstream" areas between the landfill and the Elkhart Municipal Airport.

The 25-year storm event was used as the criteria for the analysis based upon the required design rainfall parameter cited on page 3066 of the Indiana Register, Vol 18, No 11, 1 August 1995. A 50-year storm was used to size the culvert under the southern access road. Runoff volumes were computed in order to determine if sufficient storage would be available on site to store runoff from the cover sytem and tributary basins which drain onto the property.

An average annual volume of runoff from the cover system and surrounding catchments was estimated in order to evaluate the feasibility of discharging all runoff to the shallow aquifer and eliminating the need for surface runoff from the site.

3.8.2. Rainfall-Runoff Model. The HEC-1 model was set up for each of the two parts of the site drainage. Kinematic wave modeling was used to transform the precipitation excess to runoff for most of the site. Muskingum-Cunge channel routing was used where drainage ditch dimensions were available for the cover system.

The landfill and surrounding area were sub-divided into two major regions according to whether the drainage entered the north stormwater detention pond on the east side of the landfill or the west stormwater detention pond on the west side of the landfill. Those two areas were further subdivided into six subbasins each. Subbasins originating on the cover system were defined according to the flow path to the north or west stormwater detention ponds. Upstream subbasins were divided according to the culverts that they passed through enroute to the borrow areas. A map of the subbasins is shown in Figure 1 in Appendix H.

3.8.3. Model Parameters and Inputs. The HEC-1 Kinematic wave model transforms the precipitation excess to runoff based upon the loss rates provided in the model. Hydrologic routing was used to convey the runoff to the basin outlet through channels with various levels of resistance to flow. Rainfall and basin parameters were defined in order to model the runoff hydrographs from the site.

3.8.3.1. Rainfall Depth, Frequency and Duration. The rainfall depth, frequency and duration values were derived from the National Weather Service (NWS) publications "NOAA Technical Memorandum NWS HYDRO-35" and "Technical Paper No. 40" for Elkhart, Indiana. No depth-area reduction from the point rainfall was required, as the drainage area is less than 10 square miles. The rainfall values are summarized in Table 3-1 .

TABLE 3-1
RAINFALL DATA FOR THE HEC-1 MODEL FROM NWS PUBLICATIONS

Duration	Depth (inches)	
	25-Year Frequency	50-Year Frequency
5 min	0.64	0.71
15 min	1.32	1.45
60 min	2.41	2.71
2 hour	2.60	2.85
3 hour	2.80	3.10
6 hour	3.30	3.70
12 hour	3.80	4.20
24 hour	4.50	5.00

There are three rainfall measuring sites near Elkhart, Indiana that could be used to estimate the rainfall at the Himco site from future storm events. These are:

- Goshen College, IN (hourly & daily precipitation)
- South Bend WSO, IN (hourly & daily precipitation)
- White Pigeon, MI (daily precipitation)

3.8.3.2. HEC-1 Model Parameters. The areas, slopes and drainage lengths were obtained from maps of the area. Maps of the landfill cap and borrow areas were used to obtain parameters for the subbasins on the site. The USGS quadrangle maps for the area were used as a source of basin parameters for subbasins draining towards the site.

The runoff channels were defined using a number of sources. The landfill cover system design plans were used to determine the channel dimensions for the Muskingum -Cunge channel routing. The channel Manning's "n" values were estimated based upon proposed vegetative cover. These "n" values were estimated to be 0.045 for the constructed channels and 0.10 for over bank flows. Overland flow n values were assigned a value of 0.40 for the tall grass expected to cover the cap. The off-site channel parameters were estimated from aerial photographs, the quadrangle maps and the culvert sizes provided by the city of Elkhart for the channels running under the expressway to the north. Manning "n" values for overland flow through the woods and underbrush upstream of the site were assigned values of 0.60, while the channels were assigned 0.20.

The future dimensions of the borrow areas/detention ponds were developed from the preliminary plans. Those plans were modified by increasing the size of the two water bodies so that they would have sufficient volume to store the 25-year event without backing water through the culvert into the neighborhood to the east.

Loss rates were estimated using the Initial and Uniform Loss Method. Initial and uniform loss rates for the cap were assigned on the basis of earlier studies done within the branch. An initial loss rate of 0.10 inches was used for very wet antecedent conditions and a constant loss rate of 0.05 inches was used for the thin soil blanket of the cap. Loss rates for the sandy soils surrounding the project included an 0.3 inch initial loss and 2.5 inch to 5 inch per hour constant loss rate. The loss rates for the off-site subbasins were adjusted from initial estimates to match flows that would pass through the culverts within allowable headwater constraints of the expressway.

3.8.4. Peak Discharges and Runoff Volumes. The computed peak discharges and volumes from the 25-year, 24-hour design storm are listed in Table 3-2.

TABLE 3-2
DISCHARGES & RUNOFF VOLUMES FROM SELECTED SUBBASINS

Subbasin Description	Drainage Area (Acres)	Peak Flow (25-Year) (cfs)	Total Run-Off Volume (acre-feet)
Landfill Cap, North Portion (To Quarry)	33.54	117	9
At Cap Road Culvert	3.78	17	1
At East Ditch Outlet	10.37	38	3
Landfill Cap, South Portion (To Pit)	20.61	80	6
At South Ditch Outlet	18.37	74	5
All Drainage From Cap	54.15	197	15
N. & E. Basins (Incl. Off-site to Quarry)	116.29	203	21
Cap Portion	33.54	117	9
All Off-Cap Portion (Incl. Quarry)	82.75	103	12
Off-Site Through Culverts	56.96	32	7

TABLE 3-2 DISCHARGES & RUNOFF VOLUMES FROM SELECTED SUBBASINS			
Subbasin Description	**Drainage Area (Acres)**	**Peak Flow (25-Year) (cfs)**	**Total Run-Off Volume (acre-feet)**
Northwest Basins (Incl. Pit)	363.16	117	28
Cap Portion	20.61	80	6
All Off-Cap Portion (Incl. Pit)	342.55	51	22
Off-Site Through Culverts	324.5	42	17
Total Runoff Volume From All Sources			49

3.8.5. Volumes Stored And Elevations Reached. The potential to fill the storm water detention ponds with the 25-year storm runoff was evaluated. The only significant change in the basin from pre-project conditions was the increased runoff from the landfill cover system. Assumptions utilized in analyses were:

•Groundwater losses durirg 25-yr, 24 hour storm:
- -Loss to water table at starting elevation = 0 cfs
- -Loss to water table at max design pools = 0.1 cfs

•North Storm Water Detention Pond:
- -Starting water surface elevation in a dry year = 754.0 ft msl.
- -Starting water surface elevation in a wet year = 756.1 ft msl.
- -Design Surface Area: @ 756 ft msl = 23.8 acres, @ 758 ft msl = 25.2 acres

•West Storm Water Detention Pond:
- -Starting water surface elevation in a dry year = 755.0 ft msl.
- -Starting water surface elevation in a wet year = 758.2 ft msl.
- -Projected Surface Area @ 755 msl = 13.85 acres, @ 756 ft msl = 14.80, @ 758 ft msl = 18.53 acres, @ 759 ft msl = 19.61 acres

HEC-1 model supplied the following routing results:

•North Storm Water Detention Pond:
- -Full Pool Elevation = 757.1 ft msl (30" RCP inlet invert)
- -At projected size (25-yr storm)
  - -Max water surface elevation in a dry year = 755.6 ft msl.
  - -Max water surface elevation in a wet year = 757.0 ft msl.
  - -Storage = 21.4 acre-feet
  - -Peak outflow = 0 (assume blocked by flap gate on 30" RCP)

•West Storm Water Detention Pond:
- -Full Pool Elevation = 758.2 ft msl (Invert of natural swale).
- -At present size (25-year storm)
- -Max water surface elevation in a dry year = 756.7 ft msl.
- -Max water surface elevation in a wet year = 758.7 ft msl.
- -Peak Storage = 9.6 acre-feet (wet year)
- -Peak outflow = 22 cfs through swale to wetland (wet year)

3.8.6. Verification by USGS Regional Equations. USGS has developed regional equations for predicting peak discharges from ungaged watersheds for each state. The equations are published in USGS Report "Water-Resources Investigations Report 94-4002". The state of Indiana was divided into seven regions. Elkhart is located in Region 1. The equation for the 25-year peak discharge is:

Q25 = 11.8*DA^0.697 * (STOR+1) ^-0.253 * (PREC-30)^1.093

where:
Q = Peak Discharge in cubic feet per second.
DA = Contributing Drainage Area in square miles.
STOR = Percent of Contributing Drainage Area covered by lakes, parks and wetlands.
PREC = Mean annual precipitation in inches.

Where significant urbanization is present, the USGS has provided another empirical equation to adjust for man-made changes to the watershed. This was applied as needed. The results of this analysis for two sub-watersheds is shown in Table 3-3.

TABLE 3-3
COMPARISON OF COMPUTED PEAK DISCHARGES FOR THE 25-YEAR EVENT

Sub Area	Q (USGS)	Q (HEC-1)
Off Cap Subbasin B-3	5.0	7.5
Off Cap Subbasins B-2	19.0	23.0

3.8.7. Verification By Rational Method. The Rational Method was also used to check the discharges computed using the HEC-1 model, as well as to compute discharges for small drainage areas not modeled individually. The Rational Formula is of the form:

Q=CiA

where:
Q = Peak Discharge in cubic feet per second
C = A dimensionally adjusted runoff coefficient that accounts for land use, slope and runoff conveyance. A "C" value of 0.50 was selected for the landfill caps on the basis of the land use being turfed side slopes with a slope in the range of 2% to 10%.
i = Rainfall intensity in inches per hour. The rainfall intensity was derived by developing a table of rainfall intensities for durations ranging from 5 minutes to 6 hours for the 25- and 50-year rainfall events as defined in the NWS Publications Hydro -35 and TP-40 as shown in Table 3-4.

TABLE 3-4 RAINFALL INTENSITY - DURATION - FREQUENCY TABLE FOR ELKHART, INDIANA		
Frequency	**25-Year**	**50-Year**
Duration	**Intensity (iph)**	**Intensity (iph)**
5 minutes	7.68	8.52
15 minutes	5.28	5.80
60 minutes	2.41	2.71
2 hours	1.30	1.42
3 hours	0.93	1.03
6 hours	0.55	0.62

The values were then plotted to allow an intensity to be chosen for each subbasin depending upon its time of concentration (Tc). The times of concentration for overland flow were developed from a nomograph derived by P. Z. Kirpich and reproduced in many design manuals. Overland time of concentration was doubled for grassed waterways on the cover system.

A = Contributing drainage area in acres. Drainage areas were determined for selected drainage basins and sub areas of the landfill cover system. Table 3-5 summarizes the Rational Formula parameters, the resulting discharges and the peak discharge derived from the rainfall runoff model.

TABLE 3-5 RATIONAL FORMULA COEFFICIENTS AND RESULTS FOR 25-YEAR EVENT					
SUB AREA	**C**	**i**	**A**	**Q Rational**	**Q HEC-1**
Cap Subbasin A-1	0.5	7.9	3.78	15	17
Cap Subbasins A-1 & A-2	0.5	0.2	10.37	27	38
Cap Subbasin B-4	0.5	0	18.37	46	78
Road Ditch portion of B-4	0.5	9.2	1.1	5	-

3.8.8. Mean Annual Runoff. The mean annual runoff was estimated in order to determine approximately what volume of water must pass through the two storage area on the property and into the groundwater during an average year. The following assumptions were made in estimating the combined average annual runoff volume into both detention areas:

- Assumptions:
  - -Mean annual precipitation is 36 inches (Climatic Atlas).
  - -Mean annual evaporation is 34 inches (NOAA Tech Rept NWS 33).

-90% of precipitation falling on the cap will eventually go to the groundwater through the ponds. (remainder is evapotranspiration).
-2 to 10% of precipitation falling on the off-site subbasins will enter the ponds.
-100% of the precipitation falling on the ponds is runoff, but evaporation losses are subtracted from the free water surface in the balance.
-75% of precipitation falling around the ponds contributes to the ground water inflow (remainder is evapotranspiration).

•Average Annual Runoff Summary
-From landfill cover = 146 acre-feet
-From off-site subbasins = 29 acre-feet
-From detention areas = 45 acre-feet
-TOTAL TO GROUNDWATER = 220 acre-feet

•Average Annual Loss from Detention Areas to the Water Table, without raising the pool water surface elevations.
-Average Horizontal Transmissivity = 0.0022 cm/second (From Section 2.3)
-Average Vertical Transmissivity = 0
-Assume loss to water table occurs from an average 0.5 foot difference in head from pond level to water table level.
-Pond perimeters = 9270 feet
-With 4630 square feet of seepage, outflow = 242 acre-feet

•Given the assumptions, it appears that the runoff from an average year's precipitation will be conducted to the water table without surface runoff or a long-term rise in pond water levels.

3.8.9. Miscellaneous Design Information. A 24-inch RCP diameter culvert in the drainage channel near the southeast corner of project was designed using the following criteria:

•Inlet Type = headwall or Flared End Section conforming to slope.
•Length = 60 feet.
•Allowable Headwater = 4 feet.
•Channel bottom is 5 feet wide with 1V to 4H side slopes.
• Outlet control with a slope of 0.003.
•50-year storm.

The 25-Year peak discharge for cover system road ditch on the northwest corner of the cover system is 5 cfs.

3.8.10. Comments and Conclusions.

3.8.10.1. Effects of a High Water Table. Based upon ground water data presented Section 2.3.10, water levels are very close to the surface at the dump site according to observation well data collected between 1980 and 1989. In a dry year, the water table is several feet below much of the land surface. In a wet year, the water table is at the ground surface at the project's west end.

The occurrence of the high water table necessitated several changes in the dimensions of the storm water detention areas to accommodate runoff from the landfill cover system and surrounding area in wet years. The detention areas were enlarged in order to store most of the runoff from the 25-year storm on site in a wet year and all of it during drier years.

Given the final dimensions, only a modest increase in the peak discharge from the west storm water detention area to a natural swale towards the west would occur in a wet year. With a ground elevation in the swale of 758.2 ft msl and a groundwater table elevation of 759.2 ft msl, it is evident that there would be flow in the swale even if the landfill cover system were not built. Effects on the wetlands between the west storm water detention area and the Manning ditch should be minimal.

Assuming that no berm is placed across the swale and the natural ground surface west of the west storm water detention area is undisturbed, a small peak flow will be discharged to the west via the swale during the design storm. The peak will amount to 22 cfs when the 25-year, 24 hour flood is routed through the full pool. Given the wide and shallow swale dimensions, flow depths of less than one foot are anticipated. With marsh vegetation and mild slopes, no erosion damage is anticipated.

Then north storm water detention pond design dimensions were enlarged to accommodate the 25-year storm's runoff on site for the range of ground water levels recorded for the period 1980 to 1989. No water would be discharged back through the 30-inch diameter RCP to the east towards the residential area during the design storm. Any additional runoff generated by the landfill cover system would ultimately be discharged to the water table.

3.8.10.2. Implications of the Annual Groundwater Balance. In an average year, it is likely that the annual runoff can be dissipated by outflow to the groundwater table, without a progressive increase in the stages of the ponds. If several wet years were to occur back to back, it is likely that the detention areas, as well as every pond nearby would increase in size and depth.

3.8.10.3. Limit Drainage into the North Storm water Detention Pond. Given the possibility of water backing into the residential area by way of the 30-inch diameter RCP in events more severe than the 25-year storm, drainage to the north storm water detention pond should be limited to off-site inflows from the east and landfill runoff from the north and east portions of the cover system. No culverts should be placed under the road to the LFG treatment facility to drain water from off-site areas to the north into the north strom water detention pond.

3.8.10.4. Design Issues. Since an event will occur that will exceed the capacity of the west storm water detention pond, it is prudent to retain access to the swale running west towards the marsh and the Manning Ditch. No berm should be placed around the west storm water detention area so that a surface water "emergency spillway" will be provided.

A similar low-cost solution to the problems near the north storm water detention pond does not present itself. Higher ground water levels to the west make it undesirable to connect the two bodies of water. Presently, the only spillway from the north storm water detention pond is for water to back up through the 30-inch diameter RCP into the residential area east of the landfill during a big storm. A flap gate will be installed, but may not help reduce water levels in the neighborhood east of the road. Runoff from the neighborhood is a major source of inflow to the north storm water detention area. Storm water would simply pond around the entrance to the 30-inch diameter RCP east of the road if blocked by high water surface elevations in the north storm water detention area and a closed flap gate.

If it becomes necessary to store events larger than the design storm or volumes greater than the average annual runoff, expanding the detention areas northward should be considered. The initial borrow area dimensions were adjusted during design to accommodate the average annual runoff and discharge it to the regional watertable. The north storm water detention area's dimensions were also adjusted during design to accommodate the 25-year storm without water backing into the neighborhood east of the site.

3.9. DRAINAGE CHANNEL DESIGN.

3.9.1. General. Drainage channels are provided along the east and south sides of the landfill to convey cover system surface water run-off to the storm water detention ponds. The hydraulic design of the drainage channels is provided in the following sections.

3.9.2. South Channel. The south channel drains the southwest portion of the landfill cover system. This channel begins at channel station 15+50, near the south-central edge of the cap, and continues in a westerly direction where it exits into the west storm water detention pond. The peak 24-hour, 25-year discharge for the south channel was determined to be 75 cfs as discussed in Section 3.8.

3.9.2.1. Profile Computations. Water surface profiles were developed using the HEC-2 standard step backwater model version 4.6.2., dated May 1991. Cross sections for the main channel were design sections from the cover system grading plan. Exit channel cross sections were developed using the HEC-2 channel improvement option. Starting conditions were varied from normal depth, critical depth, and potential lake elevations based on ten years of ground water records, varying from 753 to 759 ft msl. At a maximum Manning roughness factor of 0.070, normal depth is 3 feet. At a minimum Manning roughness factor of 0.035, the peak velocity is 2.7 feet per second (fps). No channel protection is required for this reach. Where the channel exits the cap perimeter to a steep slope, the flow goes through critical depth with a velocity of 5.4 fps. Riprap erosion control is required for this reach. Design of the riprap protection is discussed in Section 3.9.4. A one foot high endsill at the end of the slope acts to break up the critical flow. The channel depth is three feet except for a nine foot section upstream from the endsill where the depth increases to four feet. Additional height is needed at this location because the endsill could create a hydraulic jump higher than the designed channel banks. For design conditions, freeboard for the low roughness profile varies from 0.5 to 2.0 feet, and freeboard for the high roughness profile varies from none in the main channel reach to 1.0 to 2.0 feet at the channel exit. Refer to Plates 1 and 2 in Appendix H for channel and water surface profiles for the south drainage ditch.

3.9.2.2. Channel Geometry. The main channel is trapezoidal in shape with a 5 foot bottom width and 1V to 4H side slopes. The depth of the trapezoid varies between 2 and 3 feet with a four percent breakaway slope on the landfill side and a low berm on the outside. The main channel extends approximately 1,550 feet with a slope of 0.00259. The upstream and downstream invert elevations are 763.0 and 759.0 ft msl, respectively. At the exit from the cap, the south channel drops five feet to elevation 754.0 ft msl on a 1V to 4H slope. At the bottom of the slope, a one foot high endsill will help to break up the critical flows. Downstream from the endsill, the channel continues for approximately 20 feet to elevation 752.5 ft msl. From the endsill to the end of the channel, the channel walls may be toed down to the ground elevation. Excavation may be required beyond the 20 feet to daylight into the west borrow area.

3.9.3. East Channel. The east channel drains the south- and north-east portion of the landfill cover system. This channel begins at channel station 15+50, near the south-central edge of the cover system, and continues east and then north where it exits into the northern storm water detention pond and wetlands. The channel extends about 45 feet downstream from station 0+00. The peak 24-hour, 25-year discharge for the east channel was determined to be 40 cfs as discussed in Section 3.8.

3.9.3.1. Profile Computations. Water surface profiles were developed similar to the south channel. Cross sections for the main channel and the exit portion were developed using the HEC-2 channel improvement option. Starting conditions were varied from normal depth, critical depth, and potential lake elevations based on ten years of ground water data, varying from 751 to 756 ft msl. At a maximum Manning roughness factor of 0.070, normal depth is 2.2 feet. At a minimum Manning roughness factor of 0.035, the peak velocity is 2.1 fps. No channel protection is required for this reach. Where the channel exits the cover system perimeter to a steep slope, the flow goes through critical depth with a velocity of 4.8 fps. Riprap erosion protection is provided in this reach as discussed in Section 3.9.4. A one foot high endsill at the end of the slope acts to break up the critical flow. The channel depth is 2.2 feet except for a nine foot section upstream from the endsill where the depth increases to 3.2 feet. Additional height is needed at this location because the endsill could create a hydraulic jump higher than the designed channel bank. Downstream from the endsill, a small basin prevents critical flows from migrating downstream and undermining the gabion structure. This differs from the south channel because it is not practical to daylight into the north borrow area. For design conditions, freeboard for the low roughness profile varies from 0.5 to 2.0 feet, and freeboard for the high roughness profile varies from none in the main channel reach to 0.5 to 1.5 feet at the channel exit. Refer to Plates 3 and 4 in Appendix H for channel and water surface profiles.

3.9.3.2. Channel Geometry. The main portion of the east channel configuration is the same as the south channel except for the required channel depth of 2.2 feet as opposed to 3 feet. At the exit from the cap, the east channel drops five feet to elevation 754.0 ft msl on a 1V to 4H slope. At the bottom of the slope, a one foot high endsill will help to break up the critical flows. A two foot deep basin, between elevations 754 and 752 ft msl, exists downstream from the endsill. The basin mimics the channels five foot width and 1V to 4H side slopes, but has a nine foot bottom length with 1V to 3H side slopes. The total basin length is approximately 20 feet. From the endsill to the end of the channel, the channel walls may be toed down to the ground elevation.

3.9.4. Gabion Design. Erosion protection for the east and south channels was based on peak flow velocities for the south channel. Velocity computations determined a peak flow velocity of 2.7 fps for the main channel, requiring no erosion protection. For the steep sloped sections, computed maximum velocity was 5.4 fps. Gabions were designed for the gabion structures "A" and "B" on the south and east channels, respectively. Gabion height was determined to be a minimum one foot based on the maximum computed velocity. The gabions will be continuous for 20 feet upstream from the channel "exit" from the cover system, through the steep gradient section and end sill, and downstream from the endsill for at least 20 feet. Upstream and downstream from the gabions a 12-inch thick layer of loose riprap may be required for 10 to 15 feet to have a more gradual transition in channel roughness and to protect the gabions from being undermined. The gabion structures will be wrapped with geotextile to prevent loss of fine grained soils.

3.10. SEDIMENT YIELD ANALYSIS.

3.10.1. General. Potential depletion of retention basin storage volume due to sediment deposition was assessed. The Universal Soil Loss Equation (USLE) was used to evaluate the potential long term average rate of soil erosion from the landfill cover system. The Modified Universal Soil Loss Equation (MUSLE) was applied to predict the sediment yield for the 25-year event. Computations were based on guidance from *Computation of Watershed Sediment Yield, Presented at a an HEC training course "Sediment Transport in Rivers and Reservoirs", July 1988.* Average annual sheet and rill erosion were computed using the USLE for the landfill cap area. MUSLE was used to predict sediment yield for the 25-year, 24-hour storm event.

3.10.2. USLE Parameters. The following parameters were used to calculate the average annual sheet and rill erosion: a rainfall erosion index (R) of 150 for north-central Indiana, an erosion control practice factor (P) of 1.0 for the landfill, a topographic factor (LS) of 0.69 (The topographic factor is based on a 4 percent slope and average slope length of 400 feet), a soil erodibility factor (K) of 0.30 (This soil erodibility factor is representative of soils listed as "good" for use as topsoil in the *Soil Survey for Elkhart County, Indiana published by the US Department of Agriculture, Soil Conservation Service*), and a vegetative cover factor (C) of 0.075 assuming no canopy (C1=1), 70 percent ground cover (C2=0.20), and 50 percent grass/weeds (C3=0.375). The resulting average sheet and rill erosion quantity (A) is 2.3 tons per acre per year.

3.10.3. MUSLE Parameters. The following are parameters used to compute total sediment yield for the 25-year, 24-hour storm event. The storm runoff energy factor (R) is based on peak discharges and runoff volumes from the hydrologic analysis in Section 3.8. Computations were split between on-site versus off-site runoff into the north borrow area and the west borrow area. Values of "R" range from 1967 to 4680. For on-site conditions, all other factors are the same as used for the USLE, above. For off-site conditions, the topographic factor (LS) was left at 0.69, to be conservative. The flat terrain of the surrounding area would probably yield a topographic factor one half to one third less than that used for the landfill cover system. The soil erodibility factor (K) is 0.20, representative of soils in the general area. The vegetative cover factor (C) is 0.021 assuming 30 percent canopy cover (C1=0.85), 90 percent ground cover (C2=0.10) and 90 percent grass/weeds (C3=0.25). The erosion control practice factor (P) is 1.0. The resulting sediment yield (A) into the north borrow area is 78.4 tons and 57.7 tons into the west borrow area. Assuming a soil density of 70 pounds per cubic feet (lbs/ft^3), 78.4 and 57.7 tons converts to 0.051 and 0.038 acre-feet, respectively.

3.10.4. USLE Criteria. Indiana State rule 329 IAC 2-14-19 and proposed rule 329 IAC 10-22-7, both indicate 5 tons/acre/year as the upper limit for average annual sheet and rill erosion from the final cover of a landfill cap. The EPA recommended guidance of less than 2 tons/acre/year is taken from *Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments. From the EPA Office of Solid Waste and Emergency Response, July 1989.* The resulting average annual sheet and rill erosion of 2.3 tons/acre/year is very close to the EPA recommended guidance and substantially meets existing and proposed regulations for the State of Indiana. Excessive erosion is not expected and additional volume for sediment storage is not necessary.

3.10.5. MUSLE Criteria. Indiana State rule 329 IAC 10-20-12 requires permanent storm water/sedimentation basins to be designed to handle, simultaneously, the runoff from a 24-hour, 25-year precipitation event and any required sedimentation storage. As described in the Section 3.8, the borrow areas were designed to hold the 25-year, 24-hour storm event. The design storm event requires 20 acre-feet of storage volume for flood flows in the north storm water detention pond and 27 acre-feet in the west storm water detention pond. The sediment yield from the MUSLE of 0.051 and 0.038 acre-feet is minuscule and will not require an increase in storage volume dedicated to sediment.

3.10.6. Summary. The south and east channels were designed to contain the 25-year, 24-hour storm event. Gabion structures A and B are designed to provide protection against potentially erosive flows where the south and east channels exit from the landfill cover system. A sediment yield analysis, using USLE and the MUSLE, provided average annual and total sediment yield for the 25-year, 24-hour storm event. The sediment yield values were determined to be within the criteria, requiring no storage volume dedicated to sediment.

3.11. WETLANDS

3.11.1. Impacts. The potential for this project to impact jurisdictional wetlands was investigated during a 29 August 1995 site visit. The only potential wetlands located during this site visit correspond with the August 1992 Ecological Assessment conducted by SEC Donohue for the EPA Region 5 ARCS program. The wetlands located during this site visit occur between the quarry pit pond and the landfill, as well as the fringe areas of the L-shaped pond, the small pond adjacent to the L-shaped pond, and the fringes of the quarry pond. These areas combined will comprise approximately 0.75 acres of total wetland.

3.11.2. Site Visit. During the August 1995 site visit, soil samples, vegetation samples, and hydrology investigations revealed the same results for all the wetland areas. Soil samples were taken to a depth of 36 inches. All of the samples revealed consistent sand to a depth of 36 inches. Organic surface material occurred sporadically but never to a depth of more than 0.5 inches and appeared to be no more than the previous years die back or associated leaf litter. Soils contained reddish orange redoximorphic mottles at concentrations less than 1%. The areas did not contain high levels of organic matter in the surface horizon, did not contain organic streaking in the subsurface horizons, nor was an organic pan located at the depths sampled (0 to 36 inches). Local soil mapping indicates that these areas are within a hydric soil component of Tawas. It is possible that an organic pan exists below the depth of sampling and therefore the soil map unit of Tawas will fulfill the criteria necessary to classify this area as having hydric soils.

Vegetation at these areas was dominated by Narrow Leaf Cattail (Typha augustifolia), Rough Horsetail (Equisetum hyemale), and Willow shrubs (Salix interior and Salix nigra). The cattail has a national wetland indicator of obligate while the horsetail is facultative wetland minus. The willows both have an indicator of obligate, upland. Considering this, the wetland has been determined to contain a dominance of wetland vegetation and meets the vegetative criteria of a wetland.

Hydrology at these sites was determined by secondary indicators. Although the areas were not inundated nor were the soils saturated during the site visit the secondary indicators of dominant wetland vegetation and the presence of redoximorphic mottles constitute wetland hydrology.

3.11.3. Mitigation. Based upon field investigations and proposed design, it appears as though approximately 0.5 of the 0.75 acres of wetland will be impacted by this project. Mitigation for this 0.5 acres of wetland will be accomplished by excavation in the northeast corner of the proposed North Borrow Area followed by planting the previously indicated species. Approximately 2 acres of the North Borrow Area will be excavated to an average elevation of 756 ft msl with undulating characteristics ranging from the elevation of 754 to 758 ft msl. Topsoil will be placed at a thickness of 6 inches and will preferably be obtained from on-site sources. Vegetation to be planted will consist of Typha angustifolia, Equisetum hymale, Salix interior and Salix nigra. The number of each type of plants required for mitigation will be 300, 300, 200 and 200 respectively. They will be divided equally and planted in two separate locations in the mitigation area. The Typha and the Equisetum should be planted at separate locations at the approximate elevation of 756 feet. areas should be at least 300 feet apart. The Salix should be planted in separate locations at an approximate elevation ranging from 756 to 758 ft msl. The vegetation to be planted may be obtained from on site wetland areas and be transplanted to the mitigation areas once grading has been completed and the planting area approved. On site vegetative borrow will be limited to the taking of 30 percent of an established plant colony and will be done in a manner that does not threaten the integrity of the plant colony. Plants should be excavated selectively as to leave no major portions of the plant colony barren. If it is not possible to borrow from on site sources in this manner and still retain an adequate number of specimens, then off site sources will need to be identified and utilized. If off site sources for wetland vegetation are necessary, these sources must meet the same seasonal requirements for reproduction as the on site vegetation. They must be truly representative of on site vegetation in all respects. The borrow activities and borrow sources for vegetation should be approved and supervised by an Environmental Protection Agency (EPA) biologist or EPA approved biologist. Further more, any methods selected for transplanting vegetation must ensure that the vegetation is alive and in good health at the time of transplanting. If any of the planting locations do not yield at least a 65 percent success rate at the end of one year following planting activities, they will be supplemented with a 50 percent of original replanting activity. The only exception to this may occur if the EPA determines that conditions other than the plants have caused the failure. The elevations and locations of plantings within the planting areas will be established to mimic original conditions.

If an organic pan is discovered at the wetland locations prior to or during excavation, appropriate borrow will need to be located and established at the mitigation sites. If fluctuating ground water is determined as the source of hydrology necessary to support wetland vegetation it will need to be reproduced only at the frequency necessary to support this vegetation regardless of its source. Mitigation will produce wetlands that mitigate in kind.

3.12. POST-CLOSURE MONITORING.

3.12.1. General. Post-closure of the facility includes periodic inspections of cover system features, and landfill gas and groundwater monitoring as briefly discussed in the following sections. A Draft Operations, Maintenance, and Monitoring (OM&M) Plan has been developed that outlines post-closure monitoring in more detail. The construction contractor is required to update this plan to incorporate specific equipment and operation details, catalog cut-outs, equipment maintenance schedules, and related information.

3.12.2. Landfill Cover System. On a periodic basis, a physical inspection of the cover system and appurtenances is required. During the first two years of the post-closure period, inspection will occur on a quarterly basis. Semi-annual inspection are required for the remainder of the post -closure period. In addition to these scheduled inspections, additional inspections are required following various precipitation events. Each inspection will consist of a thorough evaluation of the cover system features to determine their operational condition. Items to be inspected include security features, access roads, culverts, drainage channels, groundwater monitoring wells, landfill gas monitoring probes, landfill gas collection and treatment facilities, and the general overall condition of the cover system.

3.12.3. Off-Site Landfill Gas Monitoring. To identify the off-site release of methane, landfill gas monitoring probes will be installed around the periphery of the landfill. The gas monitoring probes will be utilized to monitor for off-site migration of LFG during construction and after final closure.

The probes are located in areas that are the most critical in term of health and safety of the public as shown on Drawing G8.04. One line of probes extend from the access road turn-around near the gabion structure at the northeast corner of the site south to the cap access road. These probes are spaced approximately 200 feet on-center and are positioned along the perimeter access road just beyond the limits of the cover system. Another line of probes extend from the southeast section of the cap access road west to near southwest corner of the cap in the construction debris area. The landfill material in this area is not included under the final cover and are being left in place at this time. The probes are located in areas that are thought to be outside of the limits of landfill material. During installation, these wells may have to be moved if landfill material is encountered. The spacing between wells is variable and is dependent on the location of the probes with respect to the adjacent residences. Near the residences, the probes are located to provide complete coverage of existing buildings. With the exception of a probe near the treatment facility, no probes are located along the northern and western perimeter of the landfill. Probes are not warranted in these areas because the excavations in the borrow areas will create ponds that act as barriers to the subsurface movement of landfill gases. One probe is located north of the treatment facility to monitor for gases that may migrate through the access road subgrade.

The gas monitoring probes consist of 10 foot long, nominal 1-inch diameter, 20 slot PVC screen installed in a 6-inch diameter borehole as shown on Drawing GD.04. A minimum two foot thick bentonite seal will be placed immediately above the granular filter pack to minimize surface water infiltration. The filter pack will meet the same gradation requirement as the new groundwater monitoring wells. The probes length were selected to allow the probes to extend to groundwater. This will allow for monitoring of the entire vadose zone at each probe locations. The screened intervals of the probes will extend into groundwater to varying depths. Each probe will be fitted with a sampling port. Each monitoring probe will be finished with a steel protective casing, a two-foot square concrete pad, and three protective posts to prevent accidental damage to the instrument.

3.12.4. Groundwater Monitoring Wells. In addition to the existing groundwater monitoring wells at the site, a total of four new monitoring wells (designated WT119A, WT119B, WT120A, and WT120B) consisting of two nested well site will be constructed south of the Himco Dump and construction debris area during remedial activities. These wells are designed to provide ground water quality information down gradient of the construction debris area where elevated levels of volatile organic compounds were detected during pre-design sampling activities. Two nested well sites are used to decrease the distance between monitoring points to a more appropriate distance given the uncertainty in the waste disposal history in the construction debris area and the detection of contaminants in groundwater obtained from the WT116 well cluster. The new monitoring wells will be located horizontally such that they are approximately equidistant between the southern edge of the construction debris area and down gradient monitoring wells WT01 and WT105A.

The newly constructed monitoring wells will be screened vertically to monitor the shallow (water table) and intermediate (approximately 60 feet below ground surface) portions of the water table aquifer. These depths are identical to those chosen during the pre-design groundwater monitoring. The materials chose for construction of these new monitoring wells, including the riser, screen, filterpack, bentonite, annular seals, and surface completions are identical to those used for wells installed during the pre-design investigation.

3.12.5. Settlement Monitoring. A total of 17 settlement gages will be installed along the crest of the cap to monitor settlement of the cover system as shown on Drawing G8.03. The gages can also be used to determine changes in slope in the LFG extraction well header. The gages consist of a metal plate connected to a rod that extends into a protective casing that is flush with the final grade. The plate will be located within the select fill layer above the geosynthetics. The gages will be installed during placement of the select fill and monitored thereafter.

3.13. PERMITTING REQUIREMENTS. The need to obtain specific permits is waived by statute under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section (e) (1), 42 United States Code 9621 (e) (1), as amended. However, the project has been designed to comply with all identified applicable or relevant and appropriate federal, state and local standards, requirements, and criteria.

3.14. **HEALTH AND SAFETY.** The specifications for the remedial action will present requirements to ensure that the Contractor performs the work in compliance with applicable regulations, especially 29 Code of Federal Regulations (CFR) 1910.120, "Hazardous Waste Operations and Emergency Response". The specifications will require the Contractor to maintain a Safety and Health Program and to prepare a Site Safety and Health Plan (SSHP) covering all work to be performed under the construction contract. The paragraphs below describe background information and decision logic involved in determining specific requirements that will be included in the specifications.

3.14.1. **Contamination Characterization.** In general, contamination was primarily found in leachate samples from the Himco Superfund Site landfill and surface soils south of the landfill area. Limited contamination was revealed from the sampling of subsurface soils, groundwater, and waste mass gas. The landfill contents themselves were not analyzed during the investigation. The contaminants of the greatest occupational health concern for this project are: Metals, VOCs, and SVOCs (See Tables 3-6 through 3-14 for specifics). These site contaminants are present in low enough concentrations that Permissable Exposure Limit (PEL) accedences are not anticipated at dust levels below 5 milligrams per meter cubed (mg/m^3). However, due to the very non-homogeneous nature of the soil at Himco Dump Superfund Site, some concern still exists for exposure and precautions will be taken to assure that the contractor can respond to potential releases of these contaminants.

3.14.2. **Hazard Assessment and Risk Analysis.** This contract will involve the soils to be excavated, soils being regraded and soils being repositioned under the landfill cap, installation of perimeter air probes, monitoring wells, landfill gas probes, handling contaminated water, treatment system construction and cap construction. These tasks have the potential to expose workers to physical, biological and chemical hazards, which are discussed below. Handling of the contaminated soil will cause the potential for exposure to all site contaminants. Inhalation and incidental ingestion are the exposure pathways of concern. The following are the tasks of greatest occupational health concern:

3.14.2.1. **General Hazards.** The following is a list of general hazards that may be encountered during mobilization, installing air perimeter probes, excavation, regrading, loading, hauling, stockpiling, installing perimeter monitoring probes, backfilling and grading the excavation, constructing the treatment system and landfill cap, installing the landfill gas probes and demobilization.

Physical hazards at the site include:

- Slips, trips, falls, etc.
- Moving equipment.
- Use of power tools.
- Trenching hazards.

- •Falling objects.
- •Noise.
- •Heat/cold stress (depending on the time of year).
- •Utilities
- •Dust
- •Methane Gas
- •Hydrogen Sulfide Gas

Biological hazards at the site include:

- •Poisonous and/or thorny vegetation.
- •Insect bites, stings.
- •Diseases and illness associated with snake and rodent bites.
- •Hospital wastes encountered at the landfill.

Chemical hazards at the site include:

- •Inadvertent ingestion of contaminated soil.
- •Inhalation of contaminated dust.
- •Dermal or eye contact with contaminated site soils.

3.14.3. Personal Protective Equipment. Because of the nature of this work, it is possible that engineering controls and work practices will not be able to provide complete control of the hazards at Himco Superfund Site, therefore, the contractor will be required to provide personal protective equipment (PPE) to all affected employees. This PPE will provide dermal and respiratory protection specific to the site hazards. The requirement for use of chemical resistant outer clothing is not so much for mitigation of dermal exposure as it is a method of ensuring adequate decontamination of workers prior to exiting the work area. Removal of outer protective clothing during decontamination will ensure that contaminated soils will not be inadvertently carried away from the site. Selection of appropriate PPE will be based on task specific hazards and air monitoring results. The Contractor will be required to establish a written personal protective equipment program in compliance with 29 CFR 1910.120(g)(5). Basic levels of protection will be similar to those listed below.

•**Level D Protection:**
- Hard hat
- Safety glasses with side shields or safety goggles.
- Work clothing as prescribed by weather.
- Steel toe and shank work boots.
- Hearing protection (if needed)

•**Modified Level D Protection** (all elements of Level D above plus):
- Disposable chemical resistant (Tyvek) outer coveralls
- Steel toe/steel shank work boots, chemically resistant or used with disposable chemical resistant boot covers
- Chemically protective outer gloves (as per PPE program).
- Surgical inner (Latex) gloves.

•**Level C Protection** (all elements of Modified Level D above plus):
- Full-face air purifying respirator (APR) with cartridges capable of purifying atmospheres contaminated with particulates and organic vapors.

•**Level B Protection** (all elements of Level C above plus):
- Positive Pressure Self-Contained Breathing Appartus (SCBA) or supplied air respirator with an escape 5 minute SCBA.

3.14.4. Initial Levels of Protection for Each Task and the Decision Logic for the Selection.

3.14.4.1. Mobilization/Site Preparation. It is anticipated that a majority of this work will be conducted in EPA Level D PPE. This part of the project will involve clearing the site for excavation, construction of temporary fencing, etc.

3.14.4.2. Excavation of Contaminated Soil. The soil to be excavated at Himco Superfund Site is not homogeneous with regard to contaminant distribution. There is also the lack of analytical results of materials under the soil cover. The site contaminants found in the Mass Gas and the leachate from the landfill does give cause for caution. The initial PPE level for this task will be Level B PPE. The Contractor can adjust the PPE level based on real-time monitoring results. The contractor will, however, be required to establish action levels for upgrading the level of PPE based upon real-time air monitoring results.

3.14.4.3. Regrading of Contaminated Soil. Due to the landfill contents disposed of at Himco Dump Superfund Site, the leachate and the trench results of the landfill, Level B PPE should be the initial PPE level during this activity.

3.14.4.4. Installation of Perimeter Landfill Gas Monitoring Probes and Groundwater Monitoring Wells. Modified Level D PPE should be sufficient for worker protection during these tasks. Workers should not be handling contaminated soils, groundwater or leachate. The only exposure should be contaminated particulates or vapors coming from the landfill itself.

3.14.4.5. Handling Contaminated Water.. After the first layer of clean fill is positioned on the landfill, all contaminated decontamination, dewatering liquids and any other contaminated liquids will be disposed of off-site. Due to the non-homogenous potential for the landfill and the dilution that should be present in the contaminated liquids, Level C PPE should be the initial PPE level during this task.

3.14.4.6. Backfilling/Grading the Excavation. When the contaminated soil has been completely covered, Level D PPE should be sufficient for worker protection as workers will only be handling and/or exposed to clean fill material.

3.14.4.7. Demobilization and Site Closeout. This task will require EPA Level D PPE. See the explanation provided in paragraph Backfilling/Grading the Excavation.

3.14.5. Air Monitoring/Sampling. Because of the potential for airborne contamination, the contractor will be required to conduct air monitoring/sampling in order to establish that the levels of respiratory protection are adequate for the task being performed. Initial levels of respiratory protection for each task will be chosen by the Contractor. Air monitoring/sampling will determine whether or not a downgrade in respiratory protection can be allowed or if an upgrade in respiratory protection is needed. In addition, it is important to monitor landfill gases to also ensure that an explosive atmosphere does not develop. See the following paragraph for specific details concerning air sampling strategy and methodology.

3.14.6. Air Sampling Strategy.

3.14.6.1. Time-Integrated Air Monitoring. The calculations for Himco Superfund Site are such that the site contaminants are present in low enough concentrations that PEL accedences are not anticipated at dust levels below 5 mg/m^3. Therefore, time-integrated air monitoring will not be performed.

3.14.6.2. Real-Time Air Monitoring. No calculations were performed to determine action levels for organic contaminants at any of the sites. The organic constituents with the lowest PELs were selected as indicator chemicals to monitor. Benzene is present in shallow groundwater at Himco Superfund Site. It has a PEL of 1 ppm. Carbon Disulfide is present in the deep groundwater and soils at Himco Superfund Site. It has a PEL of 20 ppm. Vinyl Chloride was present in the Mass Gas and leachate results and a PEL of 1 ppm. Benzene and Vinyl Chloride are the contaminants with the most restrictive PELs. Carbon disulfide is the contaminant with the next most restrictive PEL. Action levels for upgrading to Level C PPE were based upon half the PEL for each of these chemicals to be monitored for by using colorimetric tubes and an organic vapor monitor. Action levels for methane are based upon 25 percent of the Lower Explosive Limit (LEL) in open areas and 10 percent of the LEL in confined spaces. Chemical specific action levels were based upon half the PELs for Benzene, Vinyl Chloride and 1,1,2-Trichloroethane (1,1,2-TCA). This allows for working in modified Level D as long as Benzene and Vinyl Chloride are below 0.5 ppm and 1,1,2-TCA is below 5.0 ppm. Dust action levels were based upon one-half the PEL of total particulates.

3.14.6.3. Dust Suppression and Perimeter Monitoring. The contractor will be required to establish a dust suppression plan . The Himco Superfund Site potentially does pose a risk to individuals from dust. As such, it is anticipated that dust suppression will adequately reduce risk from fugitive dusts bui perimeter monitoring is also a requirement given site location and numerous off-site receptors.

3.14.7. Hazard Analysis and Prevention. Topics required by CFR 29 Part 1910, Section .120 (b)(4) CFR 29 Part 1926, Section .65 (b)(4) will be addressed in the SSHP. Where the use of a specific topic is not applicable to the project, the SSHP will include a statement to justify its omission or reduced level of detail and establish that adequate consideration was given the topic.

3.14.8. Staff Organization, Qualification, and Responsibilities. The Contractor will be required to develop an organizational structure that sets forth lines of authority, responsibility, and communication. Part of this organization will be personnel responsible for oversight and implementation of the health and safety aspects of this program. Since this site remedial action is being undertaken pursuant to CERCLA, the requirements of 29 CFR 1910.120 apply. Therefore, to ensure a "qualified" person is responsible for health and safety, the contractor will be required to utilize the services of an Industrial Hygienist certified in Comprehensive Practice by the American Board of Industrial Hygiene. The Certified Industrial Hygeniest (CIH) will have the primary responsibility for implementation, oversight, and enforcement of the health and safety aspects of this remedial action.

It will not be necessary for the CIH to be on-site for the entire duration of field work. A fully trained and experienced Site Safety and Health Officer (SSHO), responsible to the Contractor and the CIH, may be delegated to implement and continually enforce the safety and health program and site-specific plan elements on-site. The SSHO will be required to be on-site at all times.

Each crew actively working in the contaminated areas will be required to include a fully trained and experienced Safety and Health Technician to take air samples and perform air monitoring and ensure compliance with the approved SSHP. The Contractor will be required to have at least <u>one</u> person certified in first air/CPR by the Red Cross, or equivalent agency, on-site during all site operations.

3.14.9. Training. All employees working on-site who will, have to enter the contamination reduction zone (CRZ) or the exclusion zone (EZ) will meet the training requirements as specified in 29 CFR 1910.120. These employees will have completed the 40 hour hazardous waste training requirements and have three days of on-site training. All supervisory personnel will have an additional 8 hours of training as specified for management of personnel and activities associated with hazardous waste site activities. Documentation of all training will be required for all personnel. Eight hour annual refresher training will be provided to those employees who become eligible during the course of this project. Documentation pertinent to annual refresher courses as required in 29 CFR 1910.120 will also be required. All employees will be required to attend site-specific training covering site hazards, procedures, and all contents of the approved SSHP prior to entering the site. Visitor training needs are to be included as required by the contractor in the SSHP.

3.14.10. Medical Surveillance. The contractor will be required to institute a medical surveillance program meeting the minimum requirements established by 29 CFR 1910.120. In order to ensure adequate medical surveillance for the hazards at this site, the contractor will be required utilize the services of a licensed physician who is certified in Occupational Medicine by the American Board of Preventative Medicine, or who, by necessary training and experience, is Board-eligible. The Contractor will be required to provide the physician with a copy of the employees' anticipated or measured exposure, PPE use, description of the employee's duties, a copy of 29 CFR 1910.120 and information from previous examinations not readily available to the examining physician.

3.14.11. Standard Operating Safety Procedures, Engineering Controls and Work Practices. It will be established in the specifications that the contractor abide by good hygiene protocol and not allow eating, drinking or smoking in areas of the site where the inadvertent ingestion of contamination is likely. The contractor will also be required to perform work in such a manner that a buddy is always available to respond to an emergency in the Exclusion Zone (EZ). The contractor will be required to show in the SSHP that he/she is aware of proper confined space entry procedures and that he/she have all the proper instrumentation to monitor confined space atmospheres prior to entry. Equipment needed is an explosimeter, oxygen deficiency monitor and a total organic vapor detector.

3.14.12. Site Control Measures. Because contamination exists at this site, the Contractor will be required to establish work zones and site control measures to prevent the spread of contamination.

3.14.13. Personal Hygiene and Decontamination. Workers will be required to do a gross decontamination (removal of boots, gloves, coveralls etc...) followed by washing of the hands and face. This decontamination regimen will be followed prior to lunch/breaks and at the end of the work day. All workers will be required to go through this decontamination regimen.

3.14.14. Equipment Decontamination Facilities and Procedures. At the Himco Dump Superfund Site, the Contractor will be required to decontaminate all equipment that has come into contact with contamination prior to the equipment coming into the support zone.

3.14.15. Emergency Response Plan and Contingency Procedures (on-site and off-site). The Contractor will be required to prepare an emergency response plan in compliance with 29 CFR 1910.120(l).

3.14.16. Heat/Cold Stress Monitoring. Ambient weather conditions will dictate when heat and cold stress monitoring requirements are appropriate. Ambient temperature readings and the type of clothing worn will affect the type and extent of monitoring required. The contractor will be required to provide and implement protocols for heat and/or cold stress monitoring. It will be required that the contractor comply with the heat stress monitoring and prevention requirements published in National Institue of Occupational Safety and Health (NIOSH) publication No. 85-115. Cold stress monitoring will be in compliance with the American Conference of Governmental Industrial Hygeniests (ACGIH) Threshold Limit Values and Biological Exposure Indices (current edition).

3.14.17. Sanitation. The Contractor will be required to provide, in the Support Zone, potable water and washing facilities consisting of cold running water, towels and soap. At least one toilet will be made available. A clean lunch/break area will be required in the support zone.

3.14.18. Site Contaminants. Refer to Tables 3-7 through 3-14 for a list of the contaminants detected at the Himco Dump Superfund Site along with the highest detected level of each contaminan.

3.14.19. Calculations. The following formula was used to determine if site inorganic and volatile contaminants would pose a risk to workers:

$$\frac{\text{PEL or TLV*}}{\text{Max det. level}} \times \frac{10^6 \text{ mg soil}}{\text{Kg soil}} = \text{Dust level at which the PEL/TLV will be reached.}$$

* Whichever of the two is the more restrictive.

The levels of most contaminants is such that exposure to levels exceeding the OSHA PEL/TLV is highly unlikely. Using the above equation, the following table presents calculation results for inorganic and volatile contaminants showing the dust level above which the PEL/TLV could be exceeded.

TABLE 3-6
DUST PEL CALCULATIONS

Contaminant	Concentration	TLV/PEL(mg/m^3)	Dust Level
Anitomy	46.8 mg/Kg	0.5	1.07E+4 mg/m3
Arsenic	5.8 mg/Kg	0.01	1.72E+3 mg/m3
Beryllium	0.91 mg/Kg	0.002	2.20E+3 mg/m3
Chromium	13.2 mg/Kg	0.5	3.78E+4 mg/m3
Copper	216 mg/Kg	1	4.63E+3 mg/m3
Iron	10,100 mg/Kg	5	4.95E+2 mg/m3
Lead	245 mg/Kg	0.05	2.04E+2 mg/m3
Magnesium	14,000 mg/Kg	10	7.14E+2 mg/m3
Manganese	561 mg/Kg	0.2	3.57E+2 mg/m3
Mercury	0.54 mg/Kg	0.025	4.60E+4 mg/m3
Zinc	229 mg/Kg	10	4.37E+4 mg/m3
Acetone	0.14 mg/Kg	750	5.36E+9 mg/m3
2-Butanone	0.008 mg/Kg	100	1.25E+10 mg/m3
Methylene Chloride	0.016 mg/Kg	50	3.13E+9 mg/m3
Toluene	0.031 mg/Kg	50	1.61E+9 mg/m3

TABLE 3-7
VOCS' RESULTS

Compound	Subsurface Soil (ug/Kg)	Deep Groundwater (ug/L)	Shallow Groundwater (ug/L)	Leachate (ug/L)	Surface Soil (ug/Kg)
Acetone	15 - 120	270	9 J - 240	85 - 1,300	8 BJ - 140
Benzene			0.9 J - 3	32 J - 97 J	
2-Butanone		0.7 J - 1 J	0.7 J	13 - 420	2 J - 8
Bromodichloromethane		0.7 J - 2 J			
Chlorobenzene			0.9 J		
Carbon Disulfide		0.013		4 J - 130	0.8 J
Chloroethane		12	2 J	3 BJ	
Chloroform		3 J - 4 J	1 J	76 J	
1,1-Dichloroethane			3 J	5 J - 220	
1,1-Dichloroethene	5 J - 12				5 J
1,2-Dichloroethene (total)			5 J - 6 J	66 - 410	
Dibromochloromethane		1 J			
Ethyl Benzene				0.15 - 6,400 mg/L	0.7 J - 2 J
Methylene Chloride	4 J	16 J	1 BJ - 19 J	18 - 550	3 J - 16
Styrene				3 J	0.8 J
Tetrachloroethene		0.6 J		48 J	6 J
1,1,1-Trichloroethane			0.8 J - 8	520	

TABLE 3-7
VOCS' RESULTS

Compound	Subsurface Soil (ug/Kg)	Deep Groundwater (ug/L)	Shallow Groundwater (ug/L)	Leachate (ug/L)	Surface Soil (ug/Kg)
Trichloroethene		2 J	2 J - 42	11 - 550 J	0.9 J - 4 J
Toluene	4 J	0.6 J		0.063 - 480,000 mg/L	2 J - 31
Xylenes (total)				77 J - 44,000 mg/L	0.7 J - 6
Vinyl Chloride				16 - 47 J	
DDT					12 - 64
DDE					4.1

J = Estimated Concentration
B = Also Detected in Blank

TABLE 3-8
SVOCs' RESULTS

Compound	Subsurface Soil (ug/kg)	Deep Groundwater (ug/L)	Shallow Groundwater (ug/L)	Leachate (ug/L)	Surface Soil (ug/Kg)
Naphthalene				4 J - 45 J	18 J
2-Methylnapthalene				10 J - 440 J	18 J
Dimethylphthalate		7 - 9			41 J
1,4-Dichlorobenzene	75 J - 120 J				120 J -210 J
Benzoic Acid				9 J	75 J
Acenaphthene				1 J	59 J -310 J
Dibenzofuran					23 J
Fluorene					43 J - 120 J
Phenanthrene				2 J	42 J -1,500
Anthracene					82 J-240 J
Di-n-butylphthalate					92 J-490 J
Fluoranthene				7 J	17 J-2,800
Pyrene				8 J	34 J-2,000
Butylbenzylpthalate			11		300 J
Benzo(a)anthracene					25 J-1,300
Chrysene				5 J	37 J-1,600
bis(2-Ethylhexyl)phthalate		3.0	8.6	22 J - 180 J	18 J-7,800 J
Benzo(b)fluoranthene				6 J	67 J-3,200
Benzo(k)fluoranthene				3 J	82 J-1,700

TABLE 3-8
SVOCs' RESULTS

Compound	Subsurface Soil (ug/kg)	Deep Groundwater (ug/L)	Shallow Groundwater (ug/L)	Leachate (ug/L)	Surface Soil (ug/Kg)
Benzo(a)pyrene				5 J	430 J-2,200
Indeno(1,2,3-cd)pyrene				2 J	230 J-3,700
Dibenzo(a,h)anthracene					94 J-550 J
Benzo(g,h,i)perylene				2 J	250 J-3,500
Di-n-octylphthalate			8		
Carbazole					36 J
Diethylphthalate		36 - 38	2	49 J	

J = estimated value

TABLE 3-9
INORGANICS AND NITRATE/NITRITE RESULTS

Compound	Surface Soils (mg/Kg)	Leachate (mg/L)	Deep Groundwater (ug/L)	Shallow Wells (ug/L)
Aluminum		8.47 J - 356 N	138 B - 6,980	23.6(B) - 113,000
Antimony	3.1 BJ - 46.8	0.0726 J - 10.5	34.6 - 47	31.2(B) - 62.5
Arsenic	0.47 B - 5.8	0.019	4.7 B - 11.7	1.0(B) - 54.5
Barium		0.53 J - 4.7 B	100 B - 222	6.4(B) - 510
Beryllium	0.2 BJ - 0.91 BJ	1.5 BNJ* - 5.7 NJ*	2.1 BJ - 4.5 BJ	1.2(B) - 5.4
Calcium		0.55 - 288	44,400 - 145,000	14,100 - 217,000
Chromium	1.1 B - 13.2	0.0329 - 10 BNJ	4.3 - 23.8	4.3(BJ) - 354
Cobalt		3.3 BJ	5.2 B - 7.3 B	5.7(B) - 28.6(B)
Copper	1.3 B - 216	0.626 - 11.7 BJ	4.9 BJ - 10.7 BJ	3.7(B) - 139
Iron	9.8 BJ - 10,100	17.5 - 272	62 BJ - 7,890	56.5(BJ) - 39,300
Lead	0.5 BJ - 245 J	.505 J -28.3	1.8 BJ - 11.2 J	1.1(BJ) - 106(J)
Magnesium	14.6 BJ - 14,000	60.3 - 205 J*	17,200 - 50,400	2,650(B) - 41,700
Manganese	1.3 BJ - 561 J	3.15 - 9.6 B	18.2 J - 279	3.7(B) - 2,070
Mercury	0.13 J - 0.54 J	0.0013 J - 0.42 NJ	0.20	0.20(J) - 1.0(J)
Nickel		0.055	21.1 B	79.4 - 111
Potassium		27.2	758 B - 29,300	468(B) - 12,900
Selenium			2 B - 3.4 B	2.1(B) - 33.0
Silver			7.2 BJ - 12.4 J	6.9(B) - 18.4(J)
Sodium		83.4 - 415	2,960 B- 91,000	1,850(B) - 78,800

TABLE 3-9
INORGANICS AND NITRATE/NITRITE RESULTS

Compound	Surface Soils (mg/Kg)	Leachate (mg/L)	Deep Groundwater (ug/L)	Shallow Wells (ug/L)
Vanadium		0.0321 B - 4.5 BNJ	7.5 B- 14.1 BJ	4.5(BJ) - 106
Zinc	1.7 B - 229	0.713 J - 18.4	4.9 BJ - 538 J	6.1(BJ) - 390(J)
Cyanide	1.3 - 24.3	0.108 - 48.4		
Nitrate/Nitrite			0.15 - 0.48 mg/L	0.14 - 1.76 mg/L

B= reported value is less than the contract required detection limit, but greater than the instrument detection limit
J= estimated value
N= spike sample recovery not within control limits
*= duplicate analysis not within control limits

TABLE 3-10
PESTICIDES' RESULTS

Compound	Leachate (ug/L)
Aldrin	0.12 DJP - 0.13 DJP
alpha-BHC	0.017 DJ
beta-BHC	0.068 DJP - 0.097 DJP
alpha-Chlordane	0.22 DJP
gamma-Chlordane	0.028 DJP - 0.029 DJP
Dieldrin	0.073 DJP
DDT	0.29 DJP
Endosulfan II	0.048 DJP - 0.17 DJP
Heptachlor	0.023 DJP - 0.12 DJP

D= all compounds identified in an analysis at a secondary dilution factor
J= estimated value
P= pesticide/aroclor target analyte when there is greater than 25% difference between two gas chromatograph columns

TABLE 3-11 WASTE MASS GAS - VOCS' DATA	
Compound	**Range of Concentrations Detected (mg/L)**
Methyl Chloride	0.00110
Vinyl Chloride	0.00860
Methylene Chloride	0.00008
Acetone	0.00003
Carbon Disulfide	0.00030
1,1-Dichloroethene	0.00009
1,1-Dichloroethane	0.00015
1,2-Dichloroethene - TOTAL	0.00130
1,1,1-Trichloroethane	0.00030
Trichloroethene	0.00037
Benzene	0.00014
Tetrachloroethene	0.00140
Toluene	0.00060
Ethyl Benzene	0.00070
Styrene	0.00001
Xylenes	0.00130
TOTAL	0.01646

TABLE 3-12
1995 GROUNDWATER - VOCS' RESULTS

Compound	Range of Concentrations (ug/L)
Acetone	7 J
Benzene	1 J - 15 J
Bromodichloromethane	2 J - 7 J
Carbon Disulfide	0.7 J - 2 J
Chloroethane	6 J - 7 J
Chloroform	16 - 47
1,1-Dichloroethane	1 J - 7 J
1,2-Dichloroethene	1 J
Dichloropropane	1 J
Methylene Chloride	0.7 J - 9 J
Trichloroethene	0.8 J - 0.9 J

J = estimated value

TABLE 3-13
1995 GROUNDWATER - SVOCs' RESULTS

Compound	Range of Concentrations (ug/L)
Acenaphthene	3 J
Anthracene	0.3 J
Bis(2-Ethylhexyl)phthalate	13
Carbazole	6 J
Dibenzofuran	2 J
Diethylphthalate	11
Fluorene	3 J
2-Methylnaphthalene	0.5 J
Naphthalene	0.4 J
Phenanthrene	0.2 J - 0.3 J
J = estimated value	

TABLE 3-14
1995 GROUNDWATER - METALS' RESULTS

Compound	Range of Concentrations (ug/L)
Arsenic	18.5 - 23.3
Barium	237 - 347
Chromium	14.4
Cyanide	11.4
J = estimated value	

3.15. CHEMICAL DATA QUALITY MANAGEMENT

3.15.1. Purpose and Scope. A Chemical Data Quality Management (CDQM) is recommended for the responsibilities and procedures for all chemical contamination investigative and remedial activities to assure that the analytical data obtained is of sufficient quality to meet the intended usages of this project.

The CDQM will consist of the Quality Assurance Project Plan (QAPP) which is designed to provide specific guidance and quality assurance requirements for the remediation activities at the Himco Dump Superfund Site. It presents the purpose, organization, and standard operating procedures (SOPs) necessary to conduct the activities in a manner consistent with specific quality goals of precision, accuracy, completeness, representativeness, and comparability. Implementation of the procedures described in this QAPP are required for the acquisition of data of known and sufficient quality.

3.15.2. Potential Contaminants. Groundwater samples indicated traces of VOCs, SVOCs, pesticides and metals. Leachate was analyzed and traces of VOCs, SVOCs, pesticides and metals were found. Soil samples indicated VOCs, SVOCs, pesticides and metals.

3.15.3. Existing Situation. The decision document presenting the selected remedial action for the Himco Dump Superfund Site include the following actions that are covered by this CDQM:

- Construction of a composite barrier, solid waste landfill cover (cap)
- Installation of an active gas collection system including a vapor phase carbon system to treat the off-gas from the landfill
- An enclosed ground flare system
- Monitoring of groundwater to ensure effectiveness of the remedial action and to evaluate the need for future groundwater treatment.

3.15.4. General Requirements. USACE Engineering Regulation (ER) 1110-1-263, 1 October 1990, titled Chemical Data Quality Management for Hazardous Waste Remedial Activities was utilized in developing the specification.

The Contractor will prepare a separate section dealing with sample collection, analytical methods etc. known as CDQM. As part of this CDQM, all procedures and activities performed in the acquisition of chemical data will be known as the QAPP. Elements of the QAPP will include the following as a minimum.

- Table of Contents.
- Project Description.
- Chemical Data Quality Objectives.
- Contractor Project Organization and Functional Area Responsibilities.
- Field Activities.
- Laboratory Activities.
- Sampling Locations.

- Sampling and Preservation Procedures.
- Details of Sampling and Preservation Procedures.
- Field Documentation.
- Sample Chain of Custody and Transportation.
- Laboratory Analytical Procedures .
- Preventive Maintenance.
- Instrument Calibration and Frequency.
- Analytical Methods.
- Method Specific Data Quality Objectives.
- Quality Control Checks.
- Corrective Action.
- Data Reduction, Validation, and Documentation.
- Chemical Data Quality Control Deliverables.

3.15.5. **Analytical Methods and Procedures.** The analytical methods used for sample analysis will be in accordance with EPA 600/4-82-057 and EPA SW-846 Third Edition, Final Update III, December 1996. Sensitivity and detection limits of the methods shall be adequate to meet all regulatory requirements.

3.15.5.1. **Off-Gas Collection Condensate.** To characterize the influent and effluent condensateand performance of the GAC system, the following analyses will be performed:

- VOCs by EPA Method 8260B
- SVOCs by EPA Method 3550B/8270C
- H_2S (Hach Kit)

3.15.5.2. **Flare System.** To characterize the influent and effluent and performance of the GAC (vapor phase) for the flare system, samples will be analyzed for the following:

- VOCs by EPA Method 8260B
- SVOCs by EPA Method 3550B/8270 C
- H_2S (Hach Kit)

3.15.5.3. **Gas Collection Condensate.** The condensate from the gas collection system will be sampled to satisfy any discharge or TSD criteria, and/or POTW standards. Analytical requirements will include the following:

- VOCs by EPA Method 8260B
- SVOCs by EPA Method 3550B/8270C
- Pest/PCBs by EPA Method 8081A
- TAL metals by EPA Methods 3005A,3010A,3020A/6010,6020 & 7000
- Dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin(TCDD) by EPA Method 8280A.
- Oil & Grease by EPA Method 413.1
- Total Suspended Solids by EPA Method 160.3
- Carbonaceous Biochemical Oxygen (cBODs) by EPA Method 405.1
- Ammonia (NH3-N) by EPA Method 350.2
- Phosphorus by EPA Method 365.1
- Surfactants
- Phenolics by EPA Method 9066

3.15.5.4. Borrow Material. One sample from each borrow source will be collected analyzed for the parameters outlined below:

- VOCs by EPA Method 8260B
- SVOCs by EPA Method 3550B/8270C
- Pest/PCBs by EPA Method 8081A
- TAL metals by EPA Methods 3005A, 3010A, 3020A/6010,6020 & 7000

3.15.5.5. Wastewater. One water sample of wastewater will be analyzed for the parameters outlined below:

- VOCs by EPA Method 8260B
- SVOCs by EPA Method 3550B/8270C
- Pest/PCBs by EPA Method 8081A
- TAL metals by EPA Methods 3005A. 3010A, 3020A/6010,6020 & 7000
- Dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin(TCDD) by EPA Method 8280A.
- Oil & Grease by EPA Method 413.1
- Total Suspended Solids by EPA Method 160.3
- Carbonaceous Biochemical Oxygen (cBODs) by EPA Method 405.1
- Ammonia (NH3-N) by EPA Method 350.2
- Phosphorus by EPA Method 365.1
- Surfactants
- Phenolics by EPA Method 9066

3.15.5.6. Groundwater Monitoring. Twenty three (23) samples from the 23 monitoring wells will be collected and analyzed for the following:

- VOCs by EPA Method 8260B
- Semi-VOCs by EPA Method 3550B/8270C
- Pest/PCBs by EPA Method 8081A
- TAL metals by EPA Methods 3005A, 3010A ,3020A/6010,6020 & 7000

3.15.5.7. Point Source Emission

- NMOC by Method 25A 40 CFR Part 60 Vol.II

3.15.5.8. Real Time Landfill Gas Monitoring

- Monitoring for Methane

4. REAL ESTATE.

4.1. DESIGN CONSIDERATIONS. One of the primary design goals was to avoid or minimize impacts to residential properties south of the site. Per direction from USEPA, the final cover of the landfill terminated prior to encroaching significantly onto the residential properties near the construction debris area south of the landfill. The final extent of the cover system, access roads, and right-of-way requirements necessitate that an approximately 20 feet wide strip of land be obtained from the back lots of the properties which abut the southern end of the landfill. In addition, the installation of groundwater and landfill gas monitoring wells will require property acquisition and/or rights-of-entry.

4.2. BOUNDARY SURVEYS AND DEED SEARCHES. Prior to construction, an updated boundary survey will need to be performed for final property acquisition purposes. In addition, a deed search will be required to establish ownership and legal status of the properties.

4.3. RIGHT-OF-WAY REQUIREMENTS. The real estate required for the project is shown on the Right-of-Way plan on drawings G3.01 and G3.02.

4.4. TEMPORARY RELOCATIONS DURING CONSTRUCTION. It is recommended that consideration be given to temporarily relocating residents south of the landfill in the construction debris area during construction. Air quality during the regrading of the landfill refuse will be of concern due to the proximity of these properties to the landfill. In addition, the methane gas extraction system must be fully operational and tested to assure methane gas does not migrate laterally towards the residences.

5. QUANTITIES AND COST ESTIMATE.

5.1. GENERAL. Quantities estimates for the project are provided in Table 5-1. The listed quantities are for materials directly attributed to the landfill cover system (e.g. earthwork volumes, cover system material quantities, etc.). Cost estimates for the 90 percent design submittal were provided under separate cover.

TABLE 5-1
QUANTITY SUMMARY
FOR
HIMCO DUMP SUPERFUND SITE REMEDIAL ACTION

ITEM NO.	DESCRIPTION	UNIT	QUANTITY
1	Gabions	LS	1
2	Erosion Control Blanket	SY	9,000
3	Silt Fencing	LF	18,250
4	Clearing and Grubbing	AC	39
5	Landfill Refuse & Soil Excavation, Regrading, and Placement	CY	82,000
6	On-Site Borrow for Random, Foundation, and Select Fill (underwater excavation will be required)	CY	320,600
7	Off-Site Borrow for Select Fill	CY	85,500
8	Random Fill In-Place	CY	126,000
9	Foundation Fill In-Place	CY	79,000
10	Select Fill In-Place	CY	128,000
11	Off-Site Borrow for Topsoil	CY	44,000
12	Topsoil In-Place	CY	44,000
13	Geosynthetic Clay Liner	SY	260,000
14	Geomembrane	SY	260,000
15	Geocomposite	SY	295,000
16	Access Road Surfacing Material In-Place	CY	3,250
17	Landfill Gas Extraction Trench Granular Material In-Place	Ton	2,500

TABLE 5-1 QUANTITY SUMMARY FOR HIMCO DUMP SUPERFUND SITE REMEDIAL ACTION			
ITEM NO.	DESCRIPTION	UNIT	QUANTITY
18	Subdrain Trenches Granular Material In-Place	Ton	900
19	Wetland Mitigation	AC	2
20	Turf	AC	75

6. FINAL DESIGN ISSUES

6.1. GENERAL. A summary of outstanding design or construction related issues are addressed below.

6.2. BORROW SOURCES/DETENTION PONDS. USACE has developed the existing ponded areas as sources of borrow and as storm water detention areas. The PRP's will ultimately decide the size and location of the borrow areas. Consequently, the PRP's will be left with the responsibility to revise the existing design of storm water detention and/or diversion structures based on the way borrow areas are developed. USACE utilized existing land on-site to a high degree to limit the amount of off-site material that will be required and to create the detention ponds. As discussed in the hydrologic design summary for the detention ponds, the north storm water detention pond (north borrow area) is sized to accommodate inflows from a 25-year event. During storm events, the west storm water detention pond (west borrow area), which is located in a area of low topography, will discharge water toward the wetlands and Manning Ditch west of the site. During wet years when groundwater is at a higher elevation than at present, the capacity of the detention areas will be reduced. Prior to construction, the PRP will need to reevaluate the hydrologic design based on the location and configuration of the borrow ponds. If the proposed storm water detention ponds capacity is determined to be insufficient, they could be enlarged by acquiring area to the north. If this is not possible, a drainage ditch or structure may need be required to discharge directly into Manning Ditch.

6.3. REAL ESTATE. Prior to construction, the property within the final project's right-of-way as shown on the drawings will need to be acquired. In addition, property acquisition or easements will be required for items such as monitoring wells, landfill gas monitoring probes, and utilities.

6.4. WETLAND MITIGATION. USACE presents a wetlands mitigation plan is this DA and in the drawing and specifications for the proposed remedial action which takes into account the proposed use of on-site areas for borrow. The PRP will need to address wetland mitigation issues during final remediation. This may include coordination with the appropriate agencies and evaluation of the type and quantity of mitigation that is required.

6.5. GROUNDWATER MONITORING WELL ABANDONMENT. Grading around the west borrow area will require the abandonment of one groundwater monitoring well (WT103A). Current plans are not to install a new well because the abandoned well is located up to side gradient from the landfill. However, a new well can be included south of the original well if required.

6.6. CONSTRUCTION SPECIFICATIONS. The construction specifications were written to allow a party independent of the U.S. Army Corps of Engineers to administer and manage the construction contract. The party that administers the contract will need to incorporate their contract requirements into the specification package.

In addition, the firm that administers the contract will need to retain a staff of professional engineers (e.g., structural, geotechnical, civil, etc.) licensed in the State of Indiana and other technically competent individuals to review and approve the various technical contract submittals. Technical submittals related to engineering aspects of the project will need to be approved by a professional engineer(s) licensed and knowledgeable in that discipline (e.g., structural engineer reviews and approves or disapproves structural engineering submittals).

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30% Design Analysis Himco Dump Superfund Site, Sept 95

FIGURES

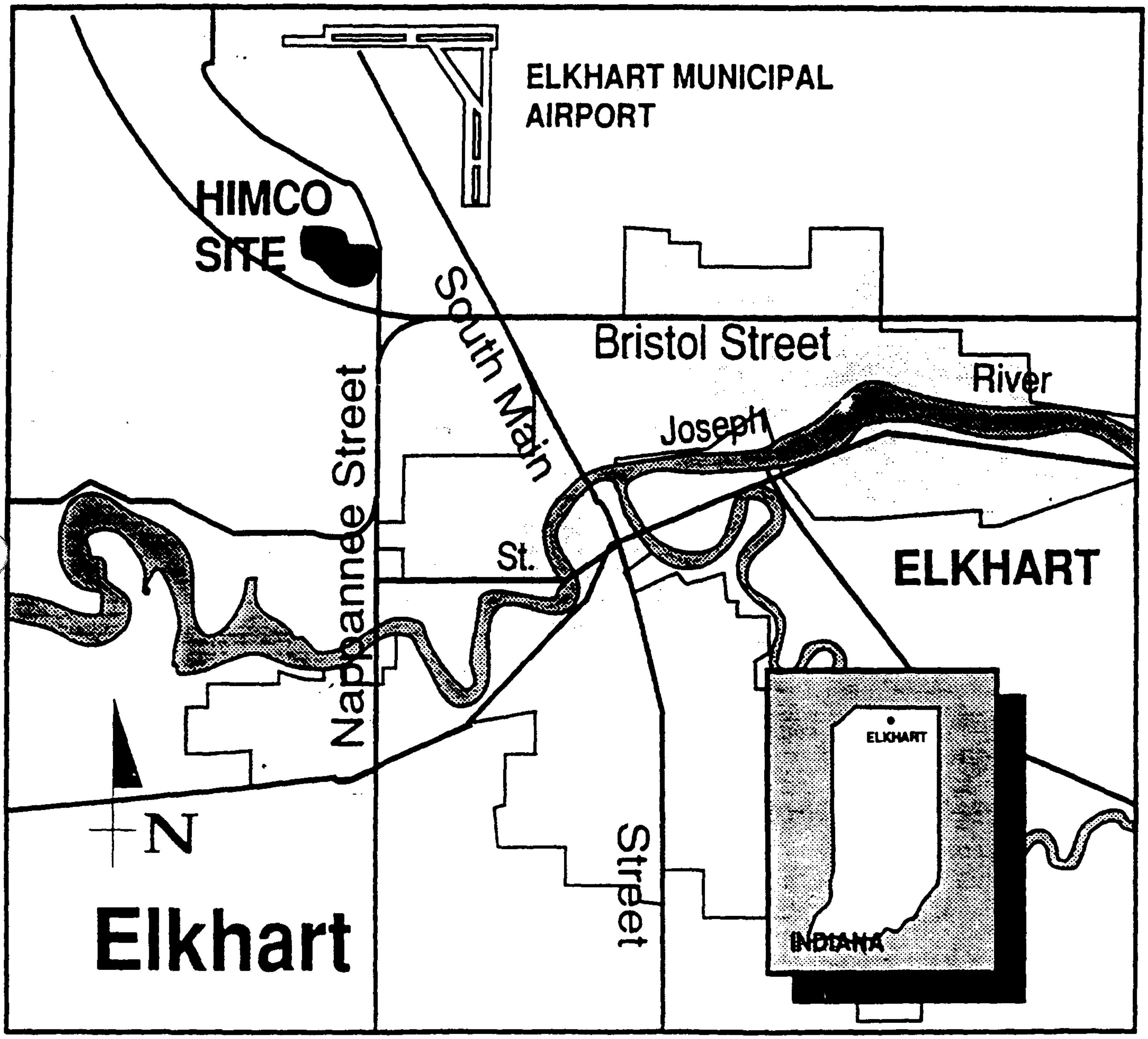

FIGURE 1. SITE LOCATION MAP

Source: USEPA Record of Decision, Himco Dump Superfund Site (1993).

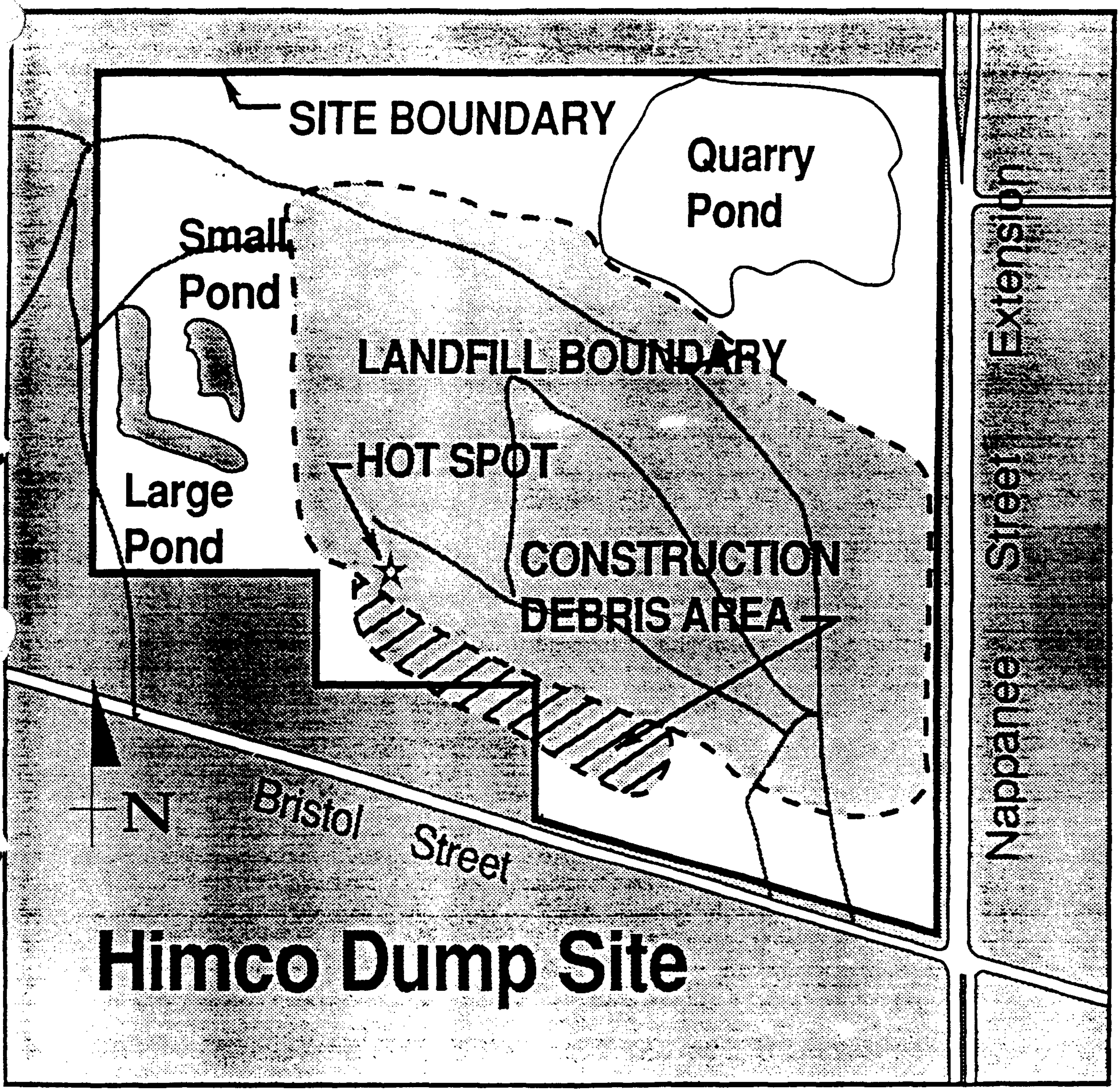

FIGURE 2. GENERAL SITE PLAN

Source: USEPA Record of Decision, Himco Dump Superfund Site (1993)

APPENDIX A

REMEDIAL ACTION

HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX A
GEOTECHNICAL/CIVIL DESIGN CALCULATIONS

TABLE OF CONTENTS

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 1	OF 2
ITEM Volume of Refuse / Trash		BY RST	DATE 10/95
		CHKD. BY BPC	DATE 20NOV95

NOTES:

∴ Relatively limited data on vertical extent of waste

∴ Numerous trenches located predominantly along southern portion of landfill

∴ Trench logs indicate that excavations apparently stopped when water or leachate were encountered. Consequently, the true extent of trash was not determined in all trenches.

∴ From trench logs, waste extended from 4 to 14' BGS (i.e. 4 to 14' thick)

ASSUMPTIONS:

- Approx. size of landfill is 58 acres
- Assume waste depth ave thickness across landfill is 10'
- Recalc. using 13' waste thickness

CALCS

∴ $V_{(10')} = (\text{Area})(\text{Thickness})$ $t = 10'$

$= (58\ \text{acres})\left(\frac{43560\ \text{sf}}{1\ \text{acre}}\right)(10') = 25{,}264{,}800\ \text{cf}$

$= 25{,}264{,}800\ \text{cf}\left(\frac{1\ \text{cy}}{27\ \text{cf}}\right) = 935{,}733\ \text{cy}$

∴ $V_{(13')} = 58\,(43560)(13)/27 = 1{,}216{,}453\ \text{cy}$

CONCLUSIONS:

Total volume of waste likely between

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Super Fund Site		SHEET NO. 2	OF 2
ITEM Volume of Refuse/Trash		BY RDT	DATE 10/95
		CHKD. BY BRC	DATE 20 NOV 95

Conclusions (Cont.)

900,000 & 1,200,000 CY. ←

Total Volume of Waste may Vary Substanially due to Limited Knowledge on Vertical Extent of Waste.

Use Waste Volume ≃ 1,050,000 CY ←

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Hingo Dump Superfund Site	SHEET NO. 1	OF 3
ITEM Refuse Density	BY RJT	DATE 11/95
	CHKD. BY BRL	DATE 20NOV95

General: The unit weight of waste can vary significantly and is generally much lower than that of earthen materials. Literature values were compared with site data to select the most appropriate value. Site data consisted of material descriptions from trenches and borings.

∴ Literature Values (For Typical Municipal Waste)

7 - 12 kN/m3		44 pcf - 76.3 pcf	Ref 1
6.8 - 16.2 kN/m3		43 pcf - 103.0 pcf	Ref 1
5 - 11 kN/m3		32 pcf - 70 pcf	Ref 2
200-500 pcy	As delivered	7.5 - 18 pcf	Ref 3
>1000 pcy	After Compaction	> 37 pcf	

Summary: For typical municipal wastes, unit weight typical varies from approx. 35 to 80 pcf.

∴ Existing Waste Summary:

Review of trench & boring logs indicate waste is primarily construction debris mixed w/ sand (i.e. concrete, metal, wood)

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump SuperFund Sites		SHEET NO. 2	OF 3
ITEM Refuse Density		BY RJT	DATE 11/95
		CHKD. BY BRC	DATE 20 Nov 95

Some areas of municipal waste. Soil Gas Survey indicates large methane production which indicates substantial organic compounds in waste in certain areas.

∴ Conclusion & Design Value:

Due to the large amount of construction debris & sand in the waste matrix, the unit weight of the material was selected as 75 pcf which is near the upper limit per literature values.

$$\gamma_w = 75 pcf \quad (MOIST)$$

$$\cong 12 \ kN/m^3$$

$$\simeq 1,200 \ kg/m^3$$

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT	HIMCO DUMP SUPERFUND SITE	SHEET NO. 3	OF 3
ITEM	REFUSE DENSITY	BY RJT	DATE 11/95
		CHKD. BY BRC	DATE 20NOV95

Ref 1: Geotechnics of Waste Fills, Theory & Practice, Landva & Knowles, ed. 1990. pg. 90

Ref 2: Geotechnics of Waste Fills, Theory & Practice, Landva & Knowles, ed. 1990. pg 227

Ref 3: Settlement of Waste Disposal Fills, Geise Sowers, 1973 8th Intl. Conf. on Soil Mechanics & Foundation Eng. pg 207-210

PROJECT Kimco Dump Scheffuro Site		SHEET NO. 1	OF
ITEM Determination of Waste Properties		BY RJT	DATE March 96
		CHKD. BY	DATE

WASTE PROPERTIES

(1) UNIT WEIGHT (γ) = $\underline{\underline{75\ pcf}}$ (SEE Refuse Density Calcs)

(2) SPECIFIC GRAVITY (G_s) ≈ 1.7 to 2.5 (Sowers, Pg 207)

- Since Large Portion of WASTE IS Construction DEBRIS & SOIL, Assume $G_s = 2.3$

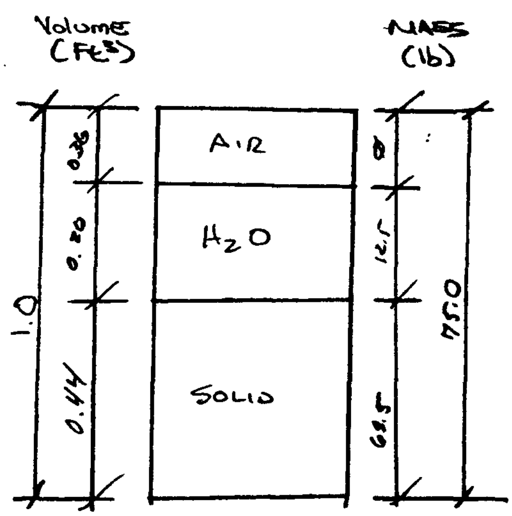
$$\boxed{G_s = 2.3}$$

(3) Moisture Content (W_c) ≈ 10-50 % (Sowers, Pg 207)

- Since Large Portion of WASTE IS Construction Debris & Soil (SANDS), which CAN NOT retain a Large volume of Water. Assume $W_c = 20\%$

$$\boxed{W_c = 20\%}$$

(4) Calculation of VOID Ratio From Previously Assumed WASTE PROPERTIES:



$M_d = \gamma_w / 1+W_c = 75/1.2 = 62.5\ pcf /_{1cf} = 62.5\ lb$

$M_{H_2O} = M_T - T_d = 75 - 62.5 = 12.5\ lb$

$V_S = M_S / \gamma_s = 62.5 / 2.3(62.4) = 0.44\ ft^3$

$V_{H_2O} = M_{H_2O} / \gamma_{H_2O} = 12.5/62.4 = 0.20$

$V_A = V_T - V_S - V_{H_2O} = 1 - 0.44 - 0.20 = 0.36$

$e = \frac{V_v}{V_s} = \frac{0.36 + 0.20}{0.44} = 1.27$

$$\boxed{e_o = 1.3}$$

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT Aimco Dump Superfund Site		SHEET NO. 2	OF
ITEM Determination of Waste Properties		BY RST	DATE March 96
		CHKD. BY	DATE

(5) $C_c \simeq (0.15 \text{ to } 0.55)(e_o)$ (Sowers, Fig 2)

0.15 For Waste w/ low organic matter
0.55 For " w/ High " "

Assume $C_c \simeq (0.20)(e_o)$, Refuse predominantly construction debris, over 20 yrs old mixed w/ sand. Some organic matter (may be wetland Remnants)

$C_c = 0.15(1.3) = 0.26$

$\boxed{C_c = 0.26}$

(6) $\alpha \simeq (0.03 \text{ to } 0.09)(e_o)$ (Sowers, Fig 3)

0.03 For Conditions unfavorable For Decay
0.09 " " Favorable " "

Assume $\alpha = 0.06\, e_o$ (See Reason stated Above)

$\alpha = 0.06(1.3) = 0.078$

$\boxed{\alpha = 0.08}$

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO SUPERFUND SITE		SHEET NO. 1	OF 5
ITEM Geotextile Design I		BY RDT	DATE 12/95
		CHKD. BY	DATE

- GEOTEXTILE DESIGN FOR FILTRATION

- DESIGN BASED ON KOERNERS "DESIGNING with Geosynthetics," 3rd ED. Chapter 2

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OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site		SHEET NO. 2	OF 5
ITEM Geotextile Design I		BY RDT	DATE 3/96
		CHKD. BY	DATE

A.) Determine Required (Design) Flow Through Geotextile

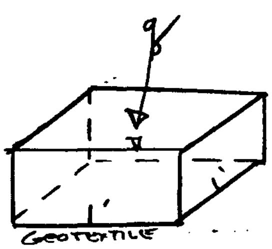
$$q = kiA = k\frac{\Delta h}{t}A$$

$$k/t = \frac{q}{\Delta H A}$$

$$\Psi_{REQ} = \frac{q}{\Delta H A}$$

where k = Hydraulic Conductivity
i = Hydraulic Gradient
A = Area
ΔH = Head Lost
t = Thickness
Ψ = Permittivity
q = Flow into Geotextile to Geonet

* From HELP Model, max daily peak precip. approx 4 in.
Assume all rain perc. to Geotextile over a 12 hour period. (Conservative)



$$q = (4''/12)(1\ SF)(1/12\ hrs) = 0.028\ cf/hr$$
$$= 7.7 \times 10^{-6}\ cfs$$

$\Delta H = 0.1'' = 0.0083$ ft. (* Assume little driving head)

$$\Psi_{REQ} = \frac{7.7 \times 10^{-6}\ cfs}{(1\ sf)(0.0083\ ft)} = 9.2 \times 10^{-4}\ s^{-1}$$

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 3	OF 5
ITEM Geotextile Design I		BY RST	DATE 3/96
		CHKD. BY	DATE

B.1 Determine Permittivity of Geotextile

$$\Psi_{Allowable} = \Psi_{ULT}\left[\frac{1}{FS_{PARTIAL}}\right]$$

$$FS_{PARTIAL} = FS_{SCB} * FS_{CR} * FS_{IN} * FS_{CC} * FS_{BC}$$

where: (PER TABLE 2.13, LANDFILL FILTERS, KOERNER)

			USE
FS_{SCB} =	FS soil clogging/binding	= 5-10	5.0
FS_{CR} =	FS creep	= 1.5-2.0	1.5 [2]
FS_{IN} =	FS intrusion	= 1.0-1.2	1.2 [3]
FS_{CC} =	FS chemical clogging	= 1.2-1.5	1.2 [1]
FS_{BC} =	FS Biological clogging	= 2.0-5.0	2.0 [1]

(1) Since Geotextile used in cover application, would not expect significant chemical or biological clogging

(2) low potential for creep on 4% slopes, short [illegible] on 4 ft slopes

(3) Intrusion potential high

$FS_P = (5.0)(1.5)(1.2)(1.2)(2.0) = 21.6$ ←

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 4	OF 5
ITEM Geotextile Design I		BY RST	DATE 3/96
		CHKD. BY	DATE

$$FS_{FLOW} = \Psi_{ALL} / \Psi_{REQD}$$

$$\Psi_{ALL} = (FS_{FLOW})(\Psi_{REQD})$$

$$\Psi_{ULT}\left[\frac{1}{FS_P}\right] = FS_{FLOW}\left[\Psi_{REQD}\right]$$

$$\Psi_{ULT} = (FS_{PARTIALS})(FS_{FLOW})(\Psi_{REQD})$$

$FS_P = 21.6$

FS_F 50

$$\Psi_{ULT} = (21.6)(50)(9.2 \times 10^{-4}\ s^{-1})$$
$$= 0.9936\ s^{-1}$$

Specify $\Psi = 1.0\ s^{-1}$

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site	SHEET NO. 1	OF 2
ITEM Geotextile Retention Calc.	BY RJT	DATE 2/13/96
	CHKD. BY	DATE

∴ Determine Soil Retention Properties of the geotextile that will be utilized on the geocomposite.

Several Methods for Evaluating Soil Retention are Presented in "Designing w/ Geosynthetics," by R. Koerner. is Provided Below.

TASK (Force #25 METHOD

- For Soil ≤ 50% Passing the No. 200 Sieve: $O_{95} < 59$mm (i.e., AOS of the Fabric ≥ No 30 Sieve.)
- For Soil 50% Passing the No. 200 Sieve: $O_{95} < 0.30$mm (i.e., AOS of the Fabric ≥ No. 50 Sieve)

GIROUD'S METHOD

$O_{95} \le (9-18)\, d_{50}/C_u$

d_{50} = Soil Particle Size, 50% Passing
C_u = Coefficient of Uniformity d_{60}/d_{10}
O_{95} = Geotextile Opening Size

CARROLL'S METHOD

$O_{95} \neq (2-3)\, d_{85}$

d_{85} = Soil Particle Size, 85% Passing

All Methods Require A Knowledge of Soil Gradation. Specs Require A Soil (Select Fill) w/ A minimum of 15% Fine (i.e. Pass #200 Sieve).

Gradations From Materials on-site that Meet This Requirement Are Provided in Appendix C.

$d_{85} \simeq$ 0.4 TO 2.5 MM (Typical Range)

$d_{60} \simeq$ 0.4 TO 0.03 mm

$d_{50} \simeq$ 0.3 TO 0.2 mm

$d_{10} \simeq$ Gradation not carried out

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 2	OF 2
ITEM Geotextile Retention Calc		BY RJT	DATE 2/13/96
		CHKD. BY	DATE

∴ USING TASK FORCE #25 METHOD w/ LESS THAN 50% PASSING NO. 200 SIEVE

AOS ≥ NO. 50 SIEVE ←

∴ USING CARROLL'S METHOD

$O_{95} \leq (2-3) d_{85}$

$O_{95} \leq (2-3)\ 0.4\ 1$ (WORST CASE)

$O_{95} \leq$ 0.8 to 1.2 mm

CLOSEST COMPARABLE SIEVES

≈ #20 TO #16 ←

∴ GIROUD METHOD NOT STRICTLY APPLICABLE GIVEN LARGE % + 200 MATERIAL.

BASED ON TASK FORCE #25 & CARROLL METHODS, MAX SIEVE SIZE IS NO. 50.

USE SMALLER AOS FOR CONSERVATISM.

USE AOS of #70 - #100 SIEVE ←

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 1	OF 3
ITEM Geotextile II		BY KST	DATE 4/96
		CHKD. BY	DATE

BURST RESISTANCE:

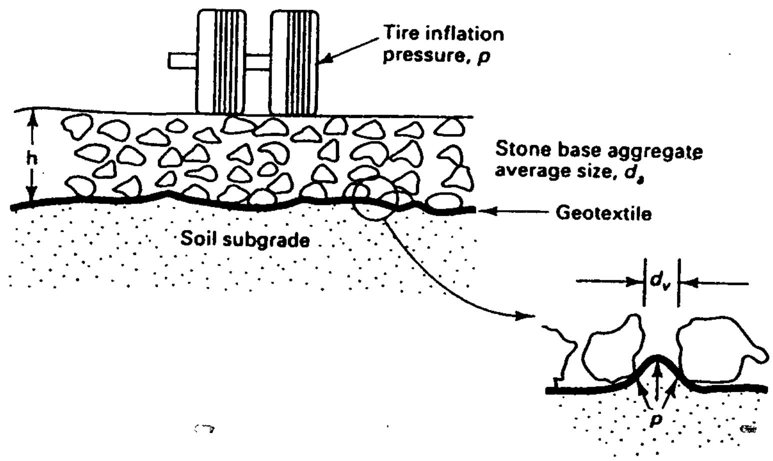

Figure 2.26 Geotextile being forced up into voids of stone base by traffic tire loads.
SOURCE: KOERNER 1994

$T_{all} = T_{ult} / FS_p$ where T_{all} = Allowable Geotextile Strength

T_{ult} = ULTIMATE GEOTEXTILE STRENGTH

FS_p = PARTIAL FACTOR of SAFETY

$FS_g = \frac{T_{all}}{T_{reqd}}$ where: T_{reqd} = Required Geotextile Strength

FS_g - Global Factor of Safety

$$FS_g = \frac{(P_{test})(d_{test})}{(FS_p)(p')(d_v)}$$

d_v = MAX VOID of STONE AND is $\cong 0.33 d_a$

d_a = AVE STONE DIA.

p' = STRESS AT Geotextile Surface

P_{test} = BURST TEST PRESSURE (ULTIMATE BURST STRENGTH)

d_{test} = diameter of Burst Test Device (= 1.2 in)

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 2	OF 3
ITEM Geotextile II		BY RST	DATE 4/96
		CHKD. BY	DATE

$$FS_P = (FS_{ID})(FS_{CR})(FS_{CD})(FS_{BD})$$

where:

FS_{ID} = Factor of Safety For Installation Damage
FS_{CR} = " " " For Creep
FS_{CD} = " " " Chemical Degradation
FS_{BD} = " " " Biological Degradation

FROM TABLE 2.12, SEPARATION, KOERNER

FS_{ID} = 1.1 to 2.5	USE	1.5 (1)
FS_{CR} = 1.5 to 2.5		1.5 (2)
FS_{CD} = 1.0 to 1.5		1.0 (3)
FS_{BD} = 1.0 to 1.2		1.1 (4)

(1) CONTRACTOR Q.C. SHOULD MINIMIZE INSTALLATION DAMAGE.
(2) LITTLE CREEP EXPECTED DUE TO FLAT SLOPES (4V:1 AND SHORT LENGTH OF 1V on 4H SLOPES
(3) Chemical Degradation should NOT BE A PROBLEM in THE COVER APPLICATION
(4) Biological Degradation Should NOT BE Significant.

SO: $FS_P = (1.5)(1.5)(1.0)(1.1)$
$\simeq 2.5$

* * ASSUME $FS_g \geq 2$ AND DETERMINE GEOTEXTILE BURST STRENGTH. FOR ASSUMED CONDITIONS

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site	SHEET NO. 3 OF 3	
ITEM Geotextile II	BY RST	DATE 4/96
	CHKD. BY	DATE

Assumptions

$FS_g = 2$

$FS_p = 2.5$

$p' = 10.5$ psi (Max pressure allowed per Spec)
** Reduced Allowable In 100% Spec For Consolidation

$d_a \cong 0.75"$ (Max allowable size for Spec)

$d_{test} = 1.2"$ (Standard)

So:

$$FS_g = \frac{(\rho_{test})(d_{test})}{FS_p (p')(d_v)} \qquad d_v = 0.33\, d_a$$

$$\rho_{test} = \frac{(FS_g)(FS_p)(p')(0.33 d_a)}{(d_{test})}$$

$$= \frac{(2)(2.5)(10.5\ \text{lb/in}^2)(0.33(0.75\ \text{in}))}{(1.2\ \text{in})}$$

$= 10.8$ psi **Min Reqd** ←

* If $p' = 50$ psi (Assume Max Tire Pressure on Cap, No Reduction Through Soil Profile)

$$\rho_{geotextile} = \frac{(2)(2.5)(50)(0.33)(0.75)}{(1.2)}$$

$= 52$ psi ←

No Min. Burst Resistance In

AASHTO M-288 Recomendations

USE 50 psi ←

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Puncture Resistance:

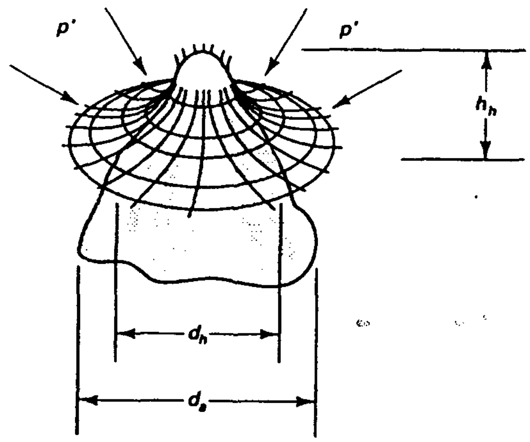

Figure 2.29 **Visualization of a stone puncturing a geotextile as pressure is applied from above.**

$$F_{reqd} = p' d_a^2 S_1 S_2 S_3 \quad (2.30)$$

where F_{reqd} = the required vertical force to be resisted,
p' = the pressure exerted on the geotextile (approximately 100% of tire inflation pressure at the ground surface for small stone thicknesses),
d_a = the average diameter of the puncturing aggregate or sharp object,
S_1 = protrusion factor = h_h/d_a,
h_h = protrusion height $\leq d_a$,
S_2 = scale factor to adjust ASTM D4833 test value using 5/16-in.-diameter puncture probe to actual puncturing object = $0.31/d_a$,
S_3 = shape factor to adjust flat puncture probe of ASTM D4833 to actual shape of puncturing object = $1 - A_p/A_c$ (values of A_p/A_c to be used

range from 0.8 for Ottawa sand, 0.7 for run-of-bank gravel, 0.4 for crushed rock, and 0.3 for shot rock),
A_p = projected area of particle, and
A_c = area of smallest circumscribed circle.

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Hinco Dump Superfund Site		SHEET NO. 2 OF 3	
ITEM Geotextile III		BY RDT	DATE 4/96
		CHKD. BY	DATE

Assumptions:

$p' = 10.5$ psi (Per Specifications) * Reduced to 7 psi in 100% Spec

$d_a = 0.75$ in (Max size of Select Fill)

$h_h \leq d_a = 0.75$ in

$S_1 = h_h/d_a = 0.75/0.75 = 1.0$

$S_2 = 0.31/d_a = 0.31/(0.75\text{ in}) = 0.41$

$S_3 = 1 - A_p/A_c$ where $\frac{A_p}{A_c} \approx 0.3$ For Shot Rock (worst case)

$= 1 - 0.3 = 0.7$

$F_{REQD} = \left(10.5 \frac{lb}{in^2}\right)\left(0.75\text{ in}\right)^2\left(1.0\right)\left(0.41\right)\left(0.7\right)$,

$= 1.7$ lb

$\approx 2.$ lb

$FS_g = \frac{F_{allow}}{F_{REQD}}$

Where:

$F_{all} = F_{GEOTEXTILE}/FS_p$

FS_p = Factor of Safety Partial

FS_g = Factor of Safety Global

F_{REQD} = See Above

$FS_p \simeq 2.5$ (See Calc For Geotextile II)

$FS_g \simeq 2.0$

$F_{GEOTEXTILE} = (FS_g)(FS_p)(F_{REQD})$

$= (2)(2.5)(2.0) = 10$ lb

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT Hinkle Dump Superfund Site		SHEET NO. 3	OF 3
ITEM Geotextile III		BY RJT	DATE 4/96
		CHKD. BY	DATE

\# Assume $P' = 50$ psi (Max Tire Pressure on Cap, No Reduction in Pressure through cover)

$F_{ROD} \cong 8$ lb

$F_{ULT\,GEO} = (8 \text{ lb})(2.5)(2.0) = 40$ lb

AASHTO M-288 Recomendation For Seperation Geotextile w/ High Degree of Survivability:

Puncture Strength = 75 lb

Use AASHTO Recomendation

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 1	OF 2
ITEM Geotextile IV		BY RJT	DATE 4/96
		CHKD. BY	DATE

TENSILE STRENGTH REQUIREMENTS

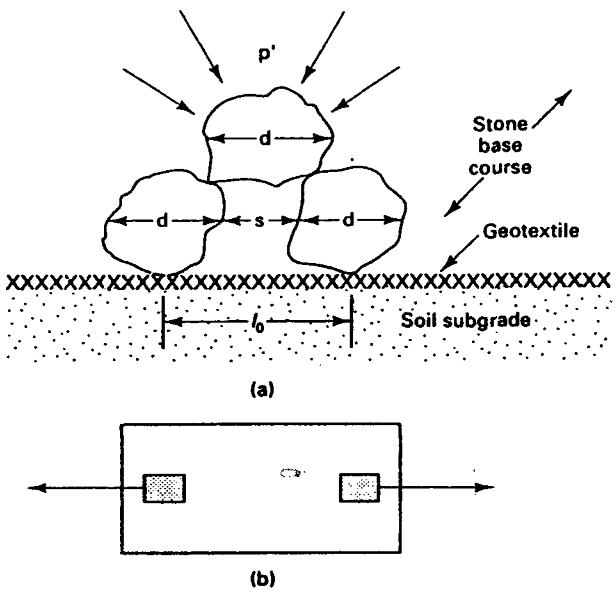

Figure 2.28 Geotextile being subjected to tensile stress as surface pressure is **applied and stone base attempts** to spread laterally: (a) actual situation; (b) analogous **grab tension test**.

$$T_{reqd} = p'(d_v)^2[f(\epsilon)]$$

where T_{reqd} = the required grab tensile force,
p' = the applied pressure,
d_v = the maximum void diameter $\simeq 0.33\ d_a$,
d_a = the average stone diameter,
$f(\epsilon)$ = the strain function of the deformed geotextile $= \frac{1}{4}\left(\frac{2y}{b} + \frac{b}{2y}\right)$,
b = width of opening (or void strain), and
y = deformation into opening (or void strain).

ASSUMPTIONS

$p' =$ 10.5 psi (Per Specifications) * Reduced to 7psi in 100% Spec

$d_a \approx$ 0.75" (Per Specifications)

$d_v = 0.75(0.33) \approx 0.25$

$y =$ 0.75 (assumed)

$b =$ 0.75 (assumed)

$f(\epsilon) = \frac{1}{4}\left(\frac{2(.75)}{(.75)} + \frac{.75}{2(.75)}\right) \doteq 0.63$

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT	Himco Dump Superfund Site	SHEET NO. 2	OF 2
ITEM	Geotextile IV	BY RJS	DATE 4/96
		CHKD. BY	DATE

$T_{REQD} = p'(d_v)^2[S(\epsilon)]$

$= 10.5 \frac{lb}{in^2}(0.25)^2(0.63)$

$= 0.43$ lb

$FS_g = \frac{T_{allow}}{T_{req}}$ where $T_{all} = T_{ult\ geotextile} / FS_p$

$FS_p \triangleq 2.5$ (see Geotextile II

$FS_g = 3.0$ (Factor of safety global)

$T_{ult\ geo} = (FS_g)(FS_p)(T_{reqd})$

$= (3.0)(2.5)(0.43) = 3.2$ lb

Assume $P' = 50$ psi (Max post construction load)

$T_{reqd} \cong 2.0$

$T_{ult} \cong (2.0)(3.0)(2.5) = 15$ lb < AASHTO M-288

T_{ult} DEFAULT = 180 lb

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Kimco Dump Superfund Site	SHEET NO. 1	OF
ITEM Geonet Design	BY RST	DATE 3/96
	CHKD. BY	DATE

Based on HELP model data, a peak daily drainage from the Geonet is approx 75 cfd per LF for a 500' drainage length.

$$q_{REQ} = 75 \text{ cfd} = 8.7 \times 10^{-4} \text{ cfs}$$

$$FS_g = \frac{q_{all}}{q_{REQD}} \quad \text{where } q_{all} = q_{ULT}\left[\frac{1}{FS_{partial}}\right]$$

$$FS_{PARTIAL} = FS_{IN} * FS_{CR} * FS_{CC} * FS_{BC}$$

where:

		Use
Intrusion potential high	$FS_{IN} = 1.3$ to 1.5	1.5
Creep potential low to min on slopes	$FS_{CR} = 1.2$ to 1.4	1.3
Chemical clogging low for cover	$FS_{CC} = 1.0$ to 1.2	1.0
Biological clogging low for cover	$FS_{BC} = 1.2$ to 1.5	1.2

(Table 4.2 Koerner)

$$FS_P = (1.5)(1.3)(1.0)(1.2) = 2.34$$

$$FS_g = \frac{q_{ULT}}{FS_P \, q_{REQ}} \Rightarrow q_{ULT} = FS_g (FS_P)(q_{REQ})$$

Use $FS_{global} = 1.0$ since flow will be based on a peak daily event which occurs on an infrequent basis & longest drainage path

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site		SHEET NO. 2	OF
ITEM Geonet Design		BY RJS	DATE 8/96
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* $q_{ULT} = (1.0)(2.34)(8.9 \times 10^{-4}\ cfs)$

$= 1.9 \times 10^{-3}$ cfs
$= 2 \times 10^{-3}$ cfs

* Using Darcy Eq.

$q = kiA$

$= kiwt = (kt)iw$ (Assumes sat. flow)

$\Theta = \frac{q}{iw}$

where:
q = Volumetric Flow Rate
k = Hydraulic Conductivity
i = Hydraulic Gradient
A = Cross Sectional Flow Area
Θ = Transmissivity
w = width
t = Thickness

$\Theta_{ULT} = \frac{2 \times 10^{-3}\ cfs}{(1\ ft)(0.04)}$

$\Theta_{ULT} = 0.05\ \frac{cfs}{ft}\left(\frac{7.48\ gal}{1\ ft^3}\right)\left(\frac{60\ s}{min}\right) \approx 22$ gpm/ft

Specify Θ = 20 gpm/ft

Note
Per manufacturer data, numerous geonets avail. with a transmissivity of 20 gpd/ft. or greater. Thickness generally > 0.3"

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☆ U.S.G.P.O.: 1993-556-577

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 3	OF
ITEM Geonet Design		BY RDT	DATE 3/96
		CHKD. BY	DATE

A HELP Model Run For THE Following Geonet Properties

Θ = 20 gpm/ft

t = 0.3"

Results in a max Head on The Geomembrane of 0.14" (Peak Daily Value). O.K.

NOTE: The select Fill is likely to be pervious based on available soils. Consequently, this layer may also act as a drainage layer if heads ever exceed the Geonet thickness.

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 1	OF 3
ITEM Design of Geonet Collector Pipe		BY RJT	DATE 3/96
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* Drainage from Geonet ≃ 70 ft^3/d per unit width for peak daily values derived from the HELP model. A drainage length of 500' on a 4% slope was modeled & represents the worst case situation.

* $Q_{REQD} = 70 \frac{ft^3}{d} \cdot \frac{1 \text{ day}}{86{,}400 \text{ sec}} = 8.1\times10^{-4}$ cfs/ft

$75 \frac{ft^3}{d} = 8.7\times10^{-4}$ "

Max Drainage Length ≅ 810'

$Q_{REQD} = 8.1\times10^{-4}(810) = 0.66$ cfs
$8.7\times10^{-4}(810) = 0.70$ cfs } 0.7 cfs

Min Drainage Length = 580'

$Q_{REQD} = 8.1\times10^{-4}(580) = 0.47$ cfs

* Since the drain will be non-pressurized slotted pipe, Manning eq. for open channel flow will be utilized

$$V = \frac{1}{n} 1.49 R_H^{0.66} S^{0.5}$$

$$Q = V \cdot A$$

where n = Roughness coefficient
R_H = Hydraulic Radius
S = slope
A = Area
V = Velocity
Q = Flow

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Kimco Dump Superfund Site		SHEET NO. 2	OF 3
ITEM Design of Geonet Collector Pipe		BY RST	DATE 3/96
		CHKD. BY	DATE

ASSUMPTIONS:

1 $A = \frac{\pi D^2}{4}$ D - Diameter For Full Flow

$R_H = \frac{D}{4}$ For Full Flow

$n = 0.025$ For Plastic Corrugated Pipe (Koerner Table 7.4)

$S = \Delta H / L$

CASE 1:

$D = 6'' = 0.5'$, $\Delta H = 3'$, $L = 810'$

$Q = \frac{1}{0.025}(1.49)(0.5/4)^{.66}(3/810)^{.5}\left(\frac{\pi(.5)^2}{4}\right)$

$= (59.6)(0.25)(0.061)(0.20)$

$\simeq 0.18$ cfs < 0.7 cfs N.G.

CASE 2: $D = 1'$ $\Delta H = 3'$ $L = 810'$

$Q = (59.6)(\underset{(0.40)}{1/4})^{.67}(0.061)(\underset{(0.78)}{\frac{\pi(1)^2}{4}})$

$Q = 1.13$ cfs > 0.7 cfs O.K

$FS = \frac{1.1}{0.7} = 1.6$

CASE 3:

$D = 8''$ $\Delta H = 3'$ $L = 810'$

$Q = (59.6)(\frac{.67}{4})^{.67}(0.061)(\pi\frac{(.67)^2}{4})$

(0.304) (0.35)

$= 0.39$ cfs < 0.7 cfs N.G

CASE 4: $D = 10''$ $\Delta H = 3$ $L = 810'$ $Q = 0.7$ cfs

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT Himco Dump SuperFund Site		SHEET NO. 3	OF 3
ITEM Design of Geonet Collector Pipe		BY RJT	DATE 3/96
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Conclusion:

A Pipe Dia. of 12" is Req. to Adequately pass Peak Flows if No intermediate outlets are constructed

* Evaluate Outlet Spacing For 6" Pipe

$Q_{6"} = 0.18$ cfs

$Q_{REQ} = 8.1 \times 10^{-4}$ cfs/SF (400')   400' Length

$= 0.324$ cfs > 0.18 cfs   N.G.

$Q_{REQ} = 8.1 \times 10^{-4}$ cfs/SF (200')   200' Length

$= 0.162$ cfs < 0.18 cfs   O.K.

* 200' Spacing of Outlets *
w/ 6" Pipe

Conclusion: Utilizing a 6" Pipe w/ outlets every 200' will pass the Anticipated Peak Flows From the Drainage Net.

There is also additional capacity in the Trench to Pass Water.

Assumes worst case situation w/ longest Possible Drainage Path

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OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT Hmco Dump Superfund Site		SHEET NO. 1	OF 16
ITEM Cover System Stability Analysis		BY RJT	DATE 4/2/98
		CHKD. BY	DATE

• Veneer stability of the cover system was analyzed using infinite slope & limit equilibrium procedures. A summary of cover system interfaces is provided below.

Cover System Interfaces 1V to 4H Side Slopes	
Upper	Lower
Select Fill	Geocomposite (NW Geotextile)
Geocomposite (NW Geotextile)	Textured Geomembrane
Textured Geomembrane	GCL (NW Geotextile)
GCL	Foundation Fill

Cover System Interfaces 4% Top Slope	
Upper	Lower
Select Fill	Geocomposite (NW Geotextile)
Geocomposite (NW Geotextile)	Smooth Geomembrane
Smooth Geomembrane	GCL (NW Geotextile)
GCL	Foundation Fill

Stability of the 1V to 4H Side Slopes governs design. For analysis, a peak interface friction angle of 18° degrees was assumed for all interfaces on the 1V to 4H side slopes. Based on experience w/ similar projects, this is a conservative assumption given the materials that will be utilized. Soils were also conservatively assigned a friction angle of 18° for analysis.

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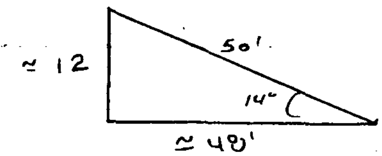
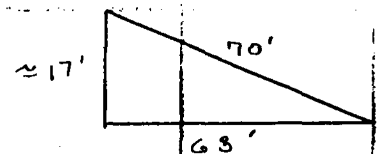
OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 2	OF 16
ITEM Stability Analysis		BY RJT	DATE 4/2/98
		CHKD. BY	DATE

Slopes Charecteristics:

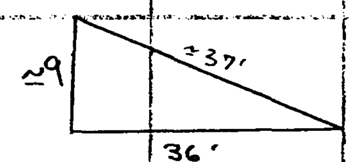
Northwest Corner: Δ Elev $\simeq$ 12'



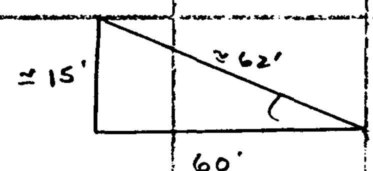
East-Center: Δ Elev. $\simeq$ 17'



South-East Corner: Δ Elev $\simeq$ 9'

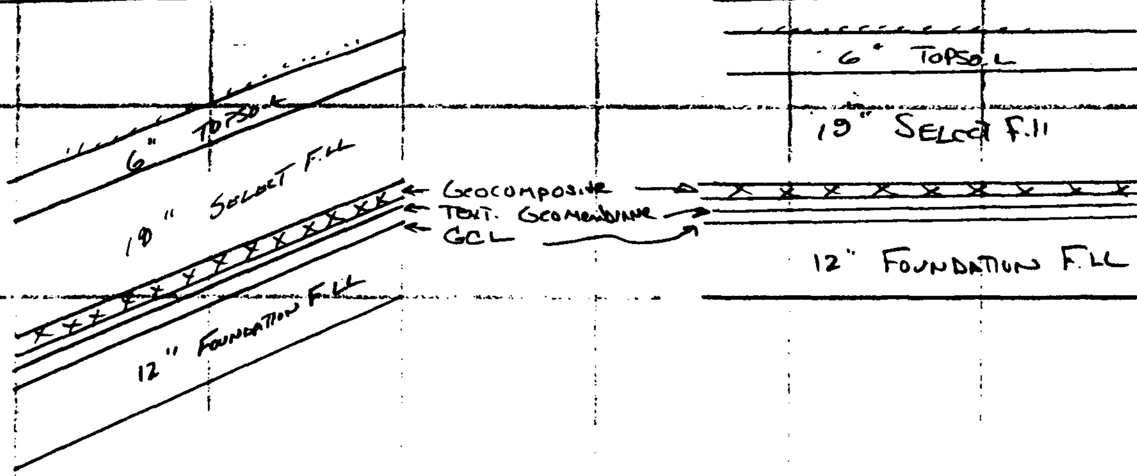


W. Central: Δ Elev $\simeq$ 15'



Typical X-Section (1V to 4H)

Typical X-Section (4% Slope)



OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site		SHEET NO. 3	OF 16
ITEM STABILITY ANALYSIS		BY RJT	DATE 4/2/98
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Infinite Slope Analysis: (1V on 4H Side Slope)

∴ NEGLECT ADHESION AND TENSION

$$FS = \frac{\tan \delta}{\tan \beta}$$

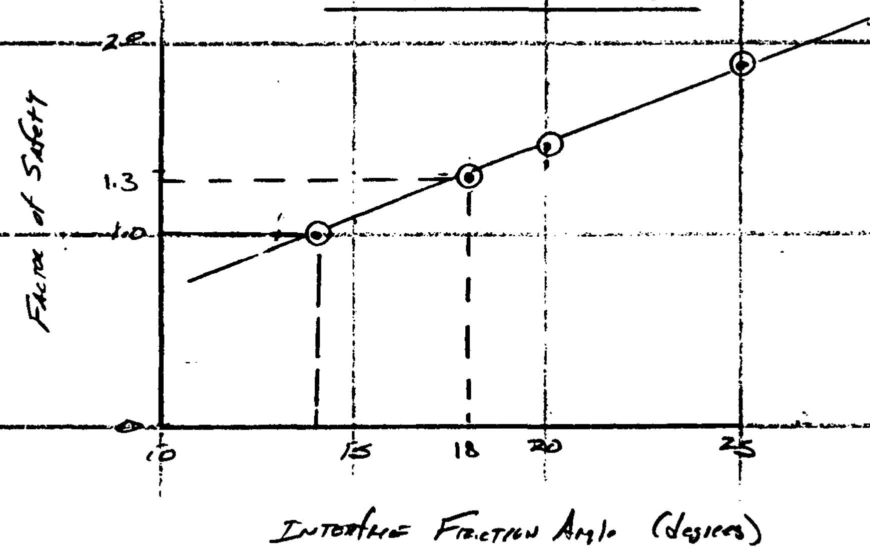
δ = Interface Friction Angle
β = Slope Angle
FS = Factor of Safety

where: $\delta = 18^\circ$
$\beta = 14^\circ$ (1V on 4H)

$$FS = \frac{\tan 18}{\tan 14} = 1.30$$

$\boxed{FS = 1.30}$

FS VS. FRICTION ANGLE



OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
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ITEM STABILITY ANALYSIS	BY RDT	DATE 4/2/98
	CHKD. BY	DATE

∴ RE EVALUATE STABILITY UTILIZING LIMIT EQUILIBRIUM PROCEDURES.

STATIC, ASSUMING NO TENSION IN GEOSYNTHETICS & NEGLECT ADHESION AND SOIL COHESION. SEE ATTACHED SPREAD SHEETS FOR ANALYSIS.

FS SUMMARY TABLE
STATIC CASE

CASE	Infinite Slope	Limit EQ. 1	Limit EQ. 2
40' Slope	1.30	1.46	1.48
70' Slope	1.30	1.39	1.39

Limit EQ 1 METHOD, GRI REPORT NO. 8
Limit EQ. 2 METHOD, GIROUD ET AL 1995
ASSUME T=Ø, C=Ø, Ad=Ø

BASED ON ANALYSIS, COVER SYSTEM WILL BE STABLE AND HAS AN ACCEPTABLE FS.

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U.S. Army Corps of Engineers, Omaha District

PROJECT:	Himco Dump Superfund Site	**LOCATION:**	Elkhart, Indiana
ITEM:	Cover Veneer Static Stability	**DATE:**	4/2/98
File:COVSTAB1.XLS		**BY:**	RJT

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS-STATIC CASE

Note: Stability Calculation Based on Limit Equilibrium Analysis Method Develped in "Stability and Tension Considerations Regarding Cover Soils on Geomembrane Lined Slopes" by Koerner and Hwu, Geosynthetic Research Institute, 1991 and GRI Report No. 8

Governing Equation: FS=(-b±(b^2-4ac)^0.5)/(2a)

1

Where:

a=0.5(γ)(L)(H)Sin^2(2β)

b=-[γ(L)(H)(Cos^2β)(Tan(δ)Sin(2β)+Ca(L)Cos(β)Sin(2β)+γ(L)(H)Sin^2(β)Tan(ϕ))Sin(2β)
+2(C)(H)Cos(β)+γ(H^2)Tan(ϕ)]

c=[γ(l)(H)Cos(β)Tan(δ)+Ca(L)][Tan(ϕ)Sin(β)Sin(2β)]

Where:

FS=	Factor of Safety
ϕ=	Soil Friction Angle
δ=	Interface Friction Angle (Soil to Geosynthetic) for critical interface
Ca=	Adhesion (Soil to Geosynthetic)
C=	Soil Cohesion
β=	Slope Angle
γ=	Unit Weight of Soil Cover
H=	Soil Cover Thickness
L=	Slope Length

U.S. Army Corps of Engineers, Omaha District

PROJECT:	Himco Dump Superfund Site	**LOCATION:**	Elkhart, Indiana
ITEM:	Cover Veneer Static Stability	**DATE:**	4/2/98
File:COVSTAB1.XLS		**BY:**	RJT

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS-STATIC CASE

CASE: 40 Foot Long, 1V to 4H Side Slope, 2 Foot Cover

INPUT VALUES			RESULTS	
ϕ=	18 degrees	0.31415927 radians	a=	881.61
δ=	18 degrees	0.31415927 radians	b=	-1350.29
Ca=	0 psf		c=	95.92
C=	0 psf			
β=	14 degrees	0.2443461 radians		
γ=	100 psf			
H=	2 ft			
L=	40 ft		**FS=**	**1.46**

CASE: 70 Foot Long, 1V to 4H Side Slope, 2 Foot Cover

INPUT VALUES			RESULTS	
ϕ=	18 degrees	0.31415927 radians	a=	1542.82
δ=	18 degrees	0.31415927 radians	b=	-2265.54
Ca=	0 psf		c=	167.87
C=	0 psf			
β=	14 degrees	0.2443461 radians		
γ=	100 psf			
H=	2 ft			
L=	70 ft		**FS=**	**1.39**

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U.S. Army Corps of Engineers, Omaha District

PROJECT: Himco Dump Superfund Site **LOCATION:** Elkhart, Indiana

ITEM: Cover Veneer Static Stability **DATE:** 4/1/98

File:COVSTAB2.XLS **BY:** RJT

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS - STATIC CASE

Note: Stability Calculation Based on Limit Equilibrium Analysis Method Develped in "Stability of Geosynthetic-Soil Layered Systems on Slopes" by Giroud, et al, 1995

Governing Equation: **FS=A+B+C+D+E**

Where:

2

A=Tan(δ)/Tan(β)

B=(Ca)/[(γ)(t)Sin(β)]

C=(t)Sin(ϕ)/[(h)Sin(2β)Cos(β+ϕ)]

D=(C)Cos(ϕ)/[(γ)(h)Sin(β)Cos(β+ϕ)]

E=(T)/[(γ)(h)(t)]

And:

FS=	Factor of Safety
ϕ=	Soil Friction Angle
δ=	Interface fFiction Angle (Soil to Geosynthetic) for Critical Interface
β=	Slope Angle
Ca=	Interface Adhesion (Soil to Geosynthetic)
C=	Soil Cohesion
γ=	Unit weight of Soil Cover
t=	Soil Cover Thickness
h=	Slope Height
T=	Tension in Geosynthetics

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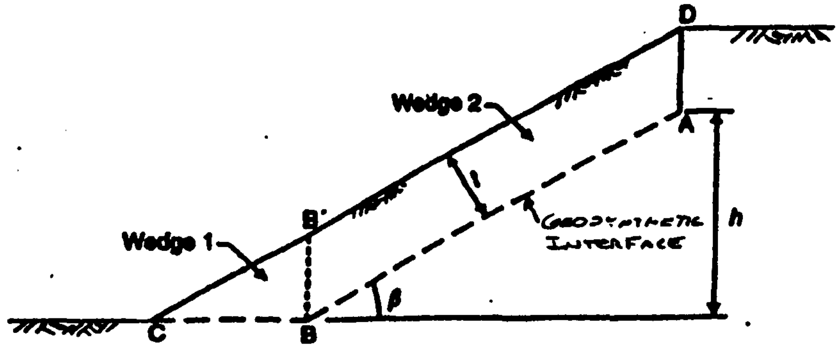

Figure 1. Definition of the two wedges used in the analysis.

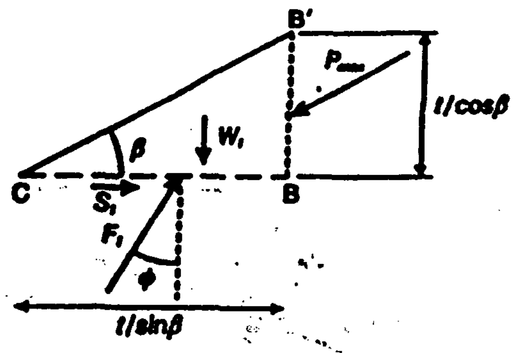

Figure 2. Wedge 1, geometry and forces.

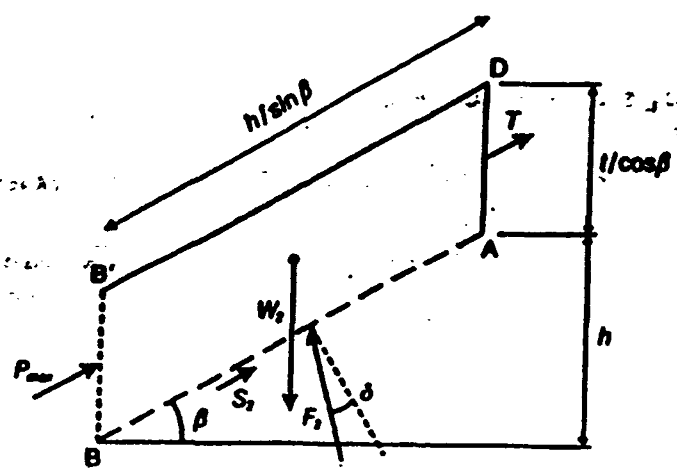

Figure 3. Wedge 2, geometry and forces.

Source: Giroud, J.P., Williams, N.D., Pele, T., and Beech, J.F., 1995, "Stability of Geosynthetic-Soil Layered Systems on Slopes", Geosynthetics International, Vol. 2, No. 6, pp 1115-1148.

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U.S. Army Corps of Engineers, Omaha District

PROJECT:	Himco Dump Superfund Site	LOCATION:	Elkhart, Indiana
ITEM:	Cover Veneer Static Stability	DATE:	4/1/98
File:COVSTAB2.XLS		BY:	RJT

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS - STATIC CASE

CASE: 40 Foot Long, 1V to 4H Side Slope, 2 Foot Cover

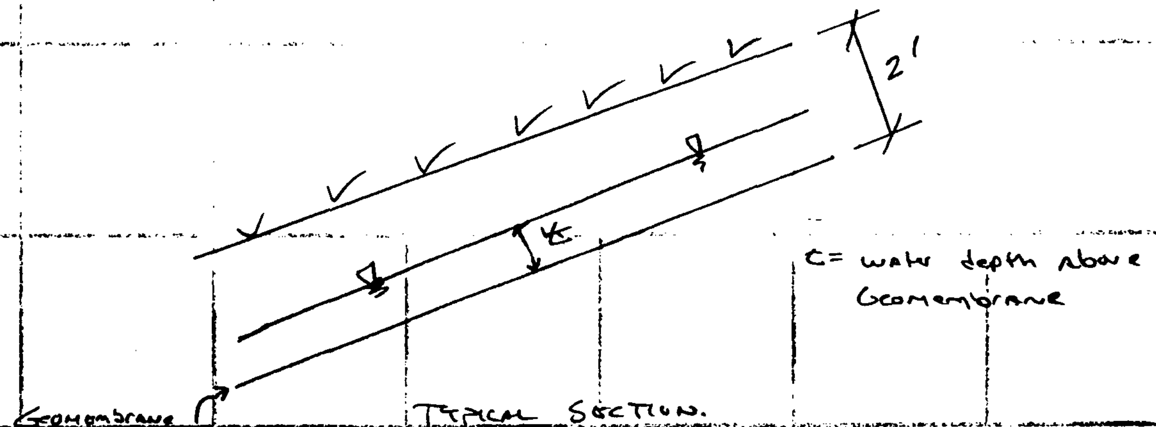
INPUT VALUES			RESULTS	
ϕ=	18 degrees	0.3142 radians	A=	1.30
δ=	18 degrees	0.3142 radians	B=	0.00
β=	14 degrees	0.2443 radians	C=	0.17
Ca=	0 psf		D=	0.00
C=	0 psf		E=	0.00
γ=	100 pcf			
t=	2 feet			
h=	9 feet		**FS=**	**1.48**
T=	0 lbf/ft			

CASE: 70 Foot Long, 1V to 4H Side Slope, 2 Foot Cover

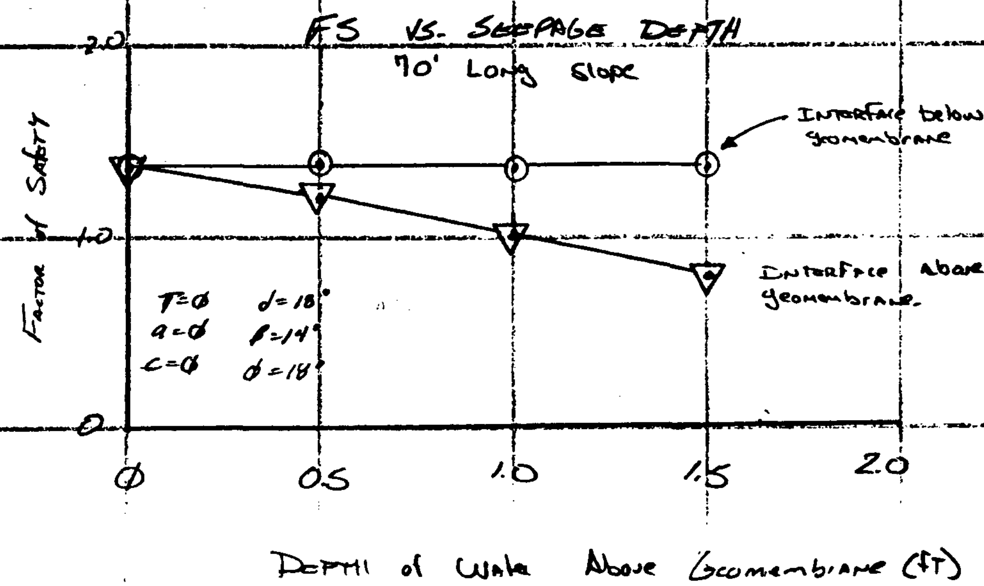
INPUT VALUES			RESULTS	
ϕ=	18 degrees	0.3142 radians	A=	1.30
δ=	18 degrees	0.3142 radians	B=	0.00
β=	14 degrees	0.2443 radians	C=	0.09
Ca=	0 psf		D=	0.00
C=	0 psf		F=	0.00
γ=	100 pcf			
t=	2 feet			
h=	17 feet		**FS=**	**1.39**
T=	0 lbf/ft			

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT	Hinco Dump Superfund Site	SHEET NO.	10 OF 16
ITEM	STABILITY ANALYSIS	BY RJT	DATE 4/2/98
		CHKD. BY	DATE

2. Evaluate Affect of Seepage Parallel to slope above Geomembrane. See Attached Spread Sheets For Calculations.



Typical Section.



As Indicated Above, Seepage parallel to the slope can Significantly reduce the FS for Interface Above the geomembrane.

Water will be controlled to Prevent Development destabilizing seepage conditions.

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U.S. Army Corps of Engineers, Omaha District

PROJECT: Himco Dump Superfund Site — **LOCATION:** Elkhart, Indiana

ITEM: Cover Veneer Static Stability — **DATE:** 4/2/98

File:COVSTAB3.XLS — **BY:** RJT

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS - SEEPAGE CASE

Note: Stability Calculation Based on Limit Equilibrium Analysis Method Develped in "Influence of Water Flow on the Stability of Geosynthetic-Soil Layered Systems on Slopes" by Giroud, et al, 1995

Governing Equations:

FS(A)=A+B+C+D+E

FS(B)=F+G+C+D+E

Where:

A=[γt*(t-tw)+γb*tw]/[γt*(t-tw)+γs*tw]*[Tan(δa)/Tan(β)]

B=(aa/Sin(β))/[γt*(t-tw)+γs*tw]

C=[γt*(t-tw')+γb*tw']/[γt*(t-tw)+γσ*tw]*[t/h]*[Sin(ϕ)/(2*Sin(β)*Cos(β)*Cos(β+ϕ))]

D=[(c*t/h)/(γt*(t-tw)+γs*tw]*[Cos(ϕ)/(Sin(β)*Cos(β+ϕ))]

E=[(T/h)]/[γt*(t-tw)+γs*tw]

F=Tan(δb)/Tan(β)

G=(ab/Sin(β))/[γt*(t-tw)+γs*tw]

And:

FS(A)=	Factor of Safety Above Geomembrane
FS(B)=	Factor of Safety Below Geomembrane
β=	Slope Angle
ϕ=	Friction angle (soil to soil)
δa=	Interface Friction Angle Above Geomembrane
δb=	Interface Friction Angle Below Geomembrane
γt=	Total Unit Wieght of Soil
γs=	Saturated Unit Wieght of Soil
γb=	Bouyant Unit Wieght of Soil
t=	Thickness of Soil Layer
tw=	Water Flow Thickness
tw'=	Water Flow Thickness in Wedge 1 (i.e., Toe Area)
aa=	Interface Adhesion Above Geomembrane
ab=	Interface Adhesion Below Geomembrane
c=	Soil Cohesion
h=	Slope Height
T=	Tension in Geosynthetics

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U.S. Army Corps of Engineers, Omaha District

PROJECT:	Himco Dump Superfund Site	LOCATION:	Elkhart, Indiana
ITEM:	Cover Veneer Static Stability	DATE:	4/2/98
File:COVSTAB3.XLS		BY:	RJT

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS - SEEPAGE

CASE: 40 Foot Long, 1V to 4H Side Slope, 2 Foot Cover, No Seepage

INPUT VALUES			RESULTS	
β=	14 degrees	0.244 radians	A=	1.30
ϕ=	18 degrees	0.314 radians	B=	0.00
δa=	18 degrees	0.314 radians	C=	0.17
δb=	18 degrees	0.314 radians	D=	0.00
γt=	110 pcf		E=	0.00
γs=	110 pcf		F=	1.30
γb=	47.6 pcf		G=	0.00
t=	2 feet			
tw=	0 feet			
tw'=	0 feet			
aa=	0 psf		FS(A)=	1.48
ab=	0 psf		FS(B)=	1.48
c=	0 psf			
h=	9 feet			
T=	0 lbf/ft			

CASE: 40 Foot Long, 1V to 4H Side Slope, 2 Foot Cover, 0.5 foot Seepage

INPUT VALUES			RESULTS	
β=	14 degrees	0.244 radians	A=	1.12
ϕ=	18 degrees	0.314 radians	B=	0.00
δa=	18 degrees	0.314 radians	C=	0.15
δb=	18 degrees	0.314 radians	D=	0.00
γt=	110 pcf		E=	0.00
γs=	110 pcf		F=	1.30
γb=	47.6 pcf		G=	0.00
t=	2 feet			
tw=	0.5 feet			
tw'=	0.5 feet			
aa=	0 psf		FS(A)=	1.27
ab=	0 psf		FS(B)=	1.45
c=	0 psf			
h=	9 feet			
T=	0 lbf/ft			

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U.S. Army Corps of Engineers, Omaha District

PROJECT:	Himco Dump Superfund Site	**LOCATION:**	Elkhart, Indiana
ITEM:	Cover Veneer Static Stability	**DATE:**	4/2/98
File:COVSTAB3.XLS		**BY:**	RJT

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS - SEEPAGE

CASE: 40 Foot Long, 1V to 4H Side Slope, 2 Foot Cover, 1 Foot Seepage

INPUT VALUES			RESULTS	
β=	14 degrees	0.244 radians	A=	0.93
ϕ=	18 degrees	0.314 radians	B=	0.00
δa=	18 degrees	0.314 radians	C=	0.12
δb=	18 degrees	0.314 radians	D=	0.00
γt=	110 pcf		E=	0.00
γs=	110 pcf		F=	1.30
γb=	47.6 pcf		G=	0.00
t=	2 feet			
tw=	1 feet			
tw'=	1 feet			
aa=	0 psf		FS(A)=	1.06
ab=	0 psf		FS(B)=	1.43
c=	0 psf			
h=	9 feet			
T=	0 lbf/ft			

CASE: 40 Foot Long, 1V to 4H Side Slope, 2 Foot Cover, 1.5 foot Seepage

INPUT VALUES			RESULTS	
β=	14 degrees	0.244 radians	A=	0.75
ϕ=	18 degrees	0.314 radians	B=	0.00
δa=	18 degrees	0.314 radians	C=	0.10
δb=	18 degrees	0.314 radians	D=	0.00
γt=	110 pcf		E=	0.00
γs=	110 pcf		F=	1.30
γb=	47.6 pcf		G=	0.00
t=	2 feet			
tw=	1.5 feet			
tw'=	1.5 feet			
aa=	0 psf		FS(A)=	0.85
ab=	0 psf		FS(B)=	1.40
c=	0 psf			
h=	9 feet			
T=	0 lbf/ft			

U.S. Army Corps of Engineers, Omaha District

PROJECT:	Himco Dump Superfund Site	**LOCATION:**	Elkhart, Indiana
ITEM:	Cover Veneer Static Stability	**DATE:**	4/2/98
File:COVSTAB3.XLS		**BY:**	RJT

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS - SEEPAGE

CASE: 70 Foot Long, 1V to 4H Side Slope, 2 Foot Cover, No Seepage

INPUT VALUES				RESULTS	
β=	14 degrees	0.244 radians		A=	1.30
ϕ=	18 degrees	0.314 radians		B=	0.00
δa=	18 degrees	0.314 radians		C=	0.09
δb=	18 degrees	0.314 radians		D=	0.00
γt=	110 pcf			E=	0.00
γs=	110 pcf			F=	1.30
γb=	47.6 pcf			G=	0.00
t=	2 feet				
tw=	0 feet				
tw'=	0 feet				
aa=	0 psf			FS(A)=	1.39
ab=	0 psf			FS(B)=	1.39
c=	0 psf				
h=	17 feet				
T=	0 lbf/ft				

CASE: 70 Foot Long, 1V to 4H Side Slope, 2 Foot Cover, 0.5 foot Seepage

INPUT VALUES				RESULTS	
β=	14 degrees	0.244 radians		A=	1.12
ϕ=	18 degrees	0.314 radians		B=	0.00
δa=	18 degrees	0.314 radians		C=	0.08
δb=	18 degrees	0.314 radians		D=	0.00
γt=	110 pcf			E=	0.00
γs=	110 pcf			F=	1.30
γb=	47.6 pcf			G=	0.00
t=	2 feet				
tw=	0.5 feet				
tw'=	0.5 feet				
aa=	0 psf			FS(A)=	1.20
ab=	0 psf			FS(B)=	1.38
c=	0 psf				
h=	17 feet				
T=	0 lbf/ft				

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U.S. Army Corps of Engineers, Omaha District

PROJECT:	Himco Dump Superfund Site	LOCATION:	Elkhart, Indiana
ITEM:	Cover Veneer Static Stability	DATE:	4/2/98
File:COVSTAB3.XLS		BY:	RJT

LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS - SEEPAGE

CASE: 70 Foot Long, 1V to 4H Side Slope, 2 Foot Cover, 1 Foot Seepage

INPUT VALUES			RESULTS	
β=	14 degrees	0.244 radians	A=	0.93
ϕ=	18 degrees	0.314 radians	B=	0.00
δa=	18 degrees	0.314 radians	C=	0.07
δb=	18 degrees	0.314 radians	D=	0.00
γt=	110 pcf		E=	0.00
γs=	110 pcf		F=	1.30
γb=	47.6 pcf		G=	0.00
t=	2 feet			
tw=	1 feet			
tw'=	1 feet			
aa=	0 psf		FS(A)=	1.00
ab=	0 psf		FS(B)=	1.37
c=	0 psf			
h=	17 feet			
T=	0 lbf/ft			

CASE: 70 Foot Long, 1V to 4H Side Slope, 2 Foot Cover, 1.5 foot Seepage

INPUT VALUES			RESULTS	
β=	14 degrees	0.244 radians	A=	0.75
ϕ=	18 degrees	0.314 radians	B=	0.00
δa=	18 degrees	0.314 radians	C=	0.05
δb=	18 degrees	0.314 radians	D=	0.00
γt=	110 pcf		E=	0.00
γs=	110 pcf		F=	1.30
γb=	47.6 pcf		G=	0.00
t=	2 feet			
tw=	1.5 feet			
tw'=	1.5 feet			
aa=	0 psf		FS(A)=	0.80
ab=	0 psf		FS(B)=	1.36
c=	0 psf			
h=	17 feet			
T=	0 lbf/ft			

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site		SHEET NO.	16 OF 16
ITEM STABILITY ANALYSIS		BY RST	DATE 4/2/98
		CHKD. BY	DATE

∴ Evaluate STABILITY of Top Slope (4%) Using An Infinite Slope Analysis.

Assumptions: $\delta = 7°$ (Assumed Worst Case - Smooth Geo. TO Geotextile)
$\beta = 23°$

$$FS = \frac{\tan \delta}{\tan \beta} = \frac{\tan 7}{\tan 23} = 3.0$$

$\boxed{FS = 3.0}$

Top Slope STABILITY Does NOT Govern Design

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site	SHEET NO. 1	OF
ITEM LFG Vent Design	BY RST	DATE 11/95
	CHKD. BY BPC	DATE 2011/95

Purpose: The Purpose of The LFG Venting System is to Provide Effective Gas Migration Control & Prevent a Pressure Buildup of the Gas under the Cap System and prevent the Physical Disruption of the Cover Components.

General Procedure:

Design will be Based on a Simple Mass Balance Approach utilizing the concept of "Radius of Influence" and Assuming 100% Recovery Efficiency. Steady State Conditions and a Gas withdrawal Rate equal to the Gas Production Rate were Assumed. It was also Assumed that no Gas is Drawn From Outside to the Well From a Distance Greater Than The Area of Influence & that all Gas Produced within the Radius of Influence is Recovered. (REF 1)

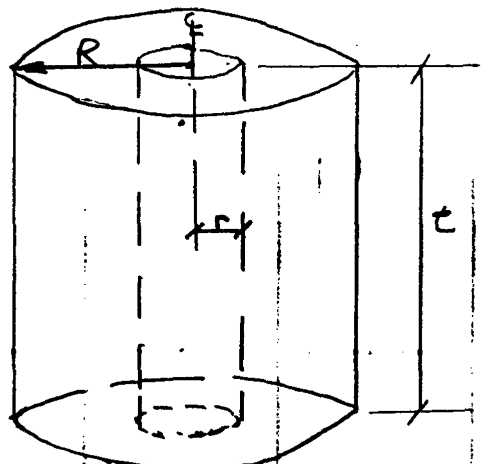
For the Stated Assumptions, Flow Rate Across an Imaginary cylindrical surface Concentric with the Well can be expressed as Follows:

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site	SHEET NO. 2 OF	
ITEM LFG Vent Design	BY AJT	DATE 11/95
	CHKD. BY BRC	DATE 20NOV95

EQ A

$$Q = \pi (R^2 - r^2) t D F_g$$

[EQ 34, REF 10]



where:

Q = Gas Flow Rate Across Cylindrical Surface
R = Well Radius of Influence
r = Borehole Radius
t = Refuse Thickness
D = Refuse Density
F_g = Gas Production Rate Per Unit Mass of Refuse.

EQ B

$$\Delta P = \frac{\mu F_g D}{2 K_s} \left[R^2 \ln\left(\frac{R}{r}\right) + \frac{r^2}{2} - \frac{R^2}{2} \right]$$

[EQ 39 REF 10]

where

ΔP = Pressure Drop Req'd at each Vent
R = Radius of Influence
r = Radius of Borehole
μ = Absolute Velocity of Gas
K_s = Apparent Permeability of Refuse (Intrinsic
D = Density of Refuse
F_g = Gas Production Rate

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Sites		SHEET NO. 3	OF
ITEM LFG VENT DESIGN		BY RJT	DATE 11/95
		CHKD. BY BRC	DATE 20 Nov 95

∴ Determine Methane & Gas Production Rates in $[m^3/kg \cdot day]$ For The Landfill.

- From QSI Passive Soil Gas Survey Report pg 5 The Landfill is Generating Approx. 287×10^6 cF/year.

$$r = \text{Methane Production Rate} = \frac{\text{Volume Gas}}{(\text{Volume Waste})(\text{Mass Waste})(\text{Time})}$$

V_w = Volume waste = 1,050,000 cf *

γ_w = Waste Density = 1,200 kg/m³

$$r_{58} = \frac{(287 \times 10^6\ \cancel{ft^3}/\cancel{yr})\cancel{\left(0.7646 \frac{m^3}{yd^3}\right)}\left(\frac{1\ yd^3}{27\ ft^3}\right)\left(\frac{1\ yr}{365\ \text{Days}}\right)}{1050000\ \cancel{yd^3}\ \cancel{\left(0.7646 \frac{m^3}{yd^3}\right)}(1200\ kg/m^3)}$$

$$= \frac{29{,}122}{1{,}260{,}000{,}000} =$$

$$= 2.3 \times 10^{-5}\ m^3/kg \cdot d$$

* Volume of Refuse For 58 Acres Site

- Soil Gas Survey Based on 45 Acre Site. Recalculate r For 45 Acres

$$r_{45} = 2.3 \times 10^{-5}\ m^3/kg \cdot d \left(\frac{58}{45}\right)$$

$$= 3.0 \times 10^{-5}\ m^3/kg \cdot d$$ * For 45 Acre site

$\boxed{\text{For Design Assume } r = 3 \times 10^{-5}\ m^3/kg \cdot d.}$

Conservative Assumption, Results in Greater rate

PROJECT	Himco Dump Superfund Site	SHEET NO. 4	OF
ITEM	LFG VENT DESIGN	BY RJT	DATE 11/95
		CHKD. BY BBC	DATE 20JUN95

- Assume Gas Production Rate (All gases produced by landfill) is double the methane generation rate. (i.e. Gas composed of 50% methane, 50% other gases)

F_g : Gas Production Rate = 2 (Methane Generation Rate)

$F_g = 2(r)$

$= 2(3 \times 10^{-5}\ m^3/kg\text{-}d)$

$$\boxed{F_g = 6 \times 10^{-5}\ m^3/kg\text{-}d}$$

- Compare calculated values for "r" and "F_g" to published values

Ref 4: Gas Production Rate ≅ 100 - 300 $\frac{scf}{(\text{ton MSW})(yr)}$

$$\left(\frac{100\ ft^3}{\text{ton-yr}}\right)\left(\frac{1\ yd^3}{27\ ft^3}\right)\left(\frac{0.7646\ m^3}{1\ yd^3}\right)\left(\frac{1\ yr}{365\ d}\right)\left(\frac{1\ ton}{2000\ lbs}\right)\left(\frac{1\ lb}{.453\ kg}\right) = 8.5 \times 10^{-6}$$

8.5×10^{-6} to $2.6 \times 10^{-5}\ \frac{m^3}{kg \cdot d}$

Ref 5: Gas Production Rate (CO_2 & CH_4) ≅ 0.035 - 1.0 $\frac{ft^3}{lb \cdot yr}$

(* Compilation of sources for, estimated & measured values from lab & field tests.)

$$.035\ \frac{ft^3}{lb\text{-}yr}\left(\frac{1\ lb}{.4537\ kg}\right)\left(\frac{1\ yr}{365\ d}\right)\left(\frac{1\ yd^3}{27\ ft^3}\right)\left(\frac{.7646\ m^3}{1\ yd^3}\right) = 6 \times 10^{-6}\ \frac{m^3}{kg \cdot d}$$

to $1.7 \times 10^{-4}\ \frac{m^3}{kg \cdot d}$

Ref 3: Gas Production Rates 0.1 to 0.6 $\frac{ft^3}{lb \cdot yr}$

(* Common values reported in literature)

1.71×10^{-5} to $1.0 \times 10^{-4}\ \frac{m^3}{kg \cdot d}$

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himio Dump Superfund Site	SHEET NO. 5	OF
ITEM LFG Vent Design	BY RJT	DATE 11/95
	CHKD. BY BRC	DATE 20DEC95

Ref 10: Methane Production Rate $\simeq$ 1.2 to 7.5 $\frac{\ell}{kg \cdot yr}$

$$1.2 \frac{\ell}{kg \cdot yr} \left(\frac{1\ yr}{365\ d}\right)\left(\frac{.001\ m^3}{1\ \ell}\right) = 3.3 \times 10^{-6} \frac{m^3}{kg \cdot d}$$

$$3.3 \times 10^{-6} \text{ to } 2.1 \times 10^{-5} \frac{m^3}{kg \cdot d}$$

- Conversion from $\frac{m^3}{kg \cdot d}$ to $\frac{ft^3}{lb \cdot yr}$

$$\left(1 \frac{m^3}{kg \cdot d}\right)\left(\frac{1\ yd^3}{0.7646\ m^3}\right)\left(\frac{27\ ft^3}{1\ yd^3}\right)\left(\frac{.4537\ kg}{1\ lb}\right)\left(\frac{365\ d}{1\ yr}\right) = 5847.8$$

Summary

Source	F_y ($m^3/kg \cdot d$)	F_y ($ft^3/lb \cdot yr$)	r ($m^3/kg \cdot d$)
Ref 4	7.5×10^{-6} to 2.6×10^{-5}	.05 to 0.15	
Ref 5	6×10^{-6} to 1.7×10^{-4}	.035 to 1.0	
Ref 3	1.7×10^{-5} to 1.0×10^{-4}	.01 to 0.6	
Ref 10			3.3×10^{-6} to 2.1×10^{-5}
Design	6×10^{-5}	0.35	3×10^{-5}

Conclusion:

Selected values for design are within typical range of values obtained from published sources.

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 6	OF
ITEM LFG Vent Design		BY RJT	DATE 11/95
		CHKD. BY BRC	DATE 29NOV95

∴ Total Gas Generated by Landfill

$$Q_{LF} = 287 \times 10^6 \frac{ft^3}{yr}\left(\frac{1yr}{365d}\right)\left(\frac{1d}{24hr}\right)\left(\frac{1hr}{60m}\right)$$

$$= 546 \; ft^3/min$$

$$Q_{LF\,(methane)} \simeq 550 \; ft^3/min$$

$$Q_{LF\,(all\ gases)} \simeq Q_{LF\,(methane)} \times 2$$

$$\simeq 1{,}100 \; ft^3/min$$

∴ Establish Flow Rates, Radius of Influence & Pressure Drops for Extraction Wells

• Typical Calculation:

Assumptions:

R = Radius of Influence = 125'

r = Well Radius = 12" = 1'

t = Refuse Thickness = 25' (Well Length + Fill Depth)

D = Waste Density = 75 pcf

FG = Gas Production Rate = 6×10^{-5} m³/kg·d

$$F_G = 6 \times 10^{-5} \frac{m^3}{kg \cdot d}\left(\frac{0.4537 \, kg}{1 \, lb}\right)\left(\frac{1 yd^3}{0.7646 \, m^3}\right)\left(\frac{27 \, ft^3}{1 yd^3}\right)\left(\frac{1 d}{1440 \, min}\right)$$

$$= 6.7 \times 10^{-7} \frac{ft^3}{lb \cdot min}$$

Q = Flow From selected well

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT	Himco Dump Superfund Site	SHEET NO. 7	OF
ITEM	LFG Vent Design	BY RJT	DATE 11/95
		CHKD. BY BBC	DATE 20NOV95

USING EQ. A : $Q = \pi(R^2 - r^2) \epsilon D F_g$

$$Q = \pi\left[(125\ ft)^2 - (1\ ft)^2\right](25\ ft)(75\ \tfrac{lb}{ft^3})\left(6.7\times10^{-7}\ \tfrac{ft^3}{lb \cdot min}\right)$$

$$= \pi\,(15624\ ft^2)(0.001072\ ft/_{min})$$

$$= 61.6$$

$$\boxed{Q_{GAS} \simeq 62\ ft^3/MIN}$$

USING EQ. B $\quad \Delta P = \dfrac{\mu F_g D}{2 k_s}\left[R^2 \ln\left(\dfrac{R}{r}\right) + \dfrac{r^2}{2} - \dfrac{R^2}{2}\right]$

$\mu_{CH_4} = 1.04 \times 10^{-5}\ \dfrac{N\text{-}Sec}{m^2}$ (METHANE) [pg 6, REF 10]

$\mu_{CO_2} = 1.39 \times 10^{-5}\ \dfrac{N\text{-}Sec}{m^2}$ (CARBON DIOXIDE)

@ 0°C & 1 ATM

For Design Assume

$\mu_{GAS} \simeq 1.15 \times 10^{-5}\ \dfrac{N\text{-}Sec}{m^2}$ [pg A-30, REF 11]

$k_s \simeq 10 - 20$ DARCIES [REF 10]

$\simeq 9.8 \times 10^{-8}$ to $2 \times 10^{-7}\ cm^2$

$k_s \simeq 1 \times 10^{-7}\ cm^2$ to $1 \times 10^{-12}\ cm^2$ [pg A-74, REF 11]

$\simeq 10$ to 0.001 DARCY

USE $k_s \simeq 10$ DARCY $\simeq 1 \times 10^{-7}\ cm^2$

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump SuperFund Site		SHEET NO. 8	OF
ITEM LFG Vent Design		BY RJT	DATE 11/95
		CHKD. BY BRC	DATE 20NOV95

$$\Delta P = \underbrace{\left[\frac{\mu F_s (D)}{2 k_s}\right]}_{(B)} \underbrace{\left[R^2 \ln\left(\frac{R}{r}\right) + \frac{r^2}{2} - \frac{R^2}{2}\right]}_{(A)}$$

(A) $\left[R^2 \ln\left(\frac{R}{r}\right) + \frac{r^2}{2} - \frac{R^2}{2}\right] \Rightarrow$

$$\left[125^2 \ln\left(\frac{125}{1}\right) + \frac{1^2}{2} - \frac{125^2}{2}\right] = 42{,}483\ ft^2$$

$$42483\ ft^2 \left(\frac{.305\ m}{1\ ft}\right)^2 = 3952\ m^2$$

(B) $$\frac{\mu F_s D}{2 k_s} = \frac{\left(1.15\times10^{-5}\ \frac{N\text{-}sec}{m^2}\right)\left(6\times10^{-5}\ \frac{m^3}{m^2\text{-}D}\right)\left(1200\ kg/m^3\right)\left(\frac{1\ D}{86400\ s}\right)}{2\left(1\times10^{-7}\ cm^2\right)\left(\frac{1\ m}{100\ cm}\right)^2}$$

$$= \frac{9.58\times10^{-12}\ N/m^2}{2\times10^{-11}\ m^2}$$

$$= 4.79\times10^{-1}\ N/m^4$$

$\Delta P = (B)(A)$

$= (3952\ m^2)(4.79\times10^{-1}\ N/m^4)$

$= 1894\ N/m^2$

$1\ N/m^2 = 1$ pascal $-$ 0.0040 in H_2O @ 60 °C

$\Delta P = 1894(0.004)$

$$\boxed{\Delta P = 7.6 \text{ inches } H_2O}$$

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 9	OF
ITEM LFG Vent Design		BY RAT	DATE 3/96
		CHKD. BY	DATE

* TOTAL GAS FLOW

- 9 WELLS ALONG CREST
- $Q_{single\ well} \simeq 62$ cfm
- $Q_{All\ wells} \approx 9(62) \approx 560$ cfm ←

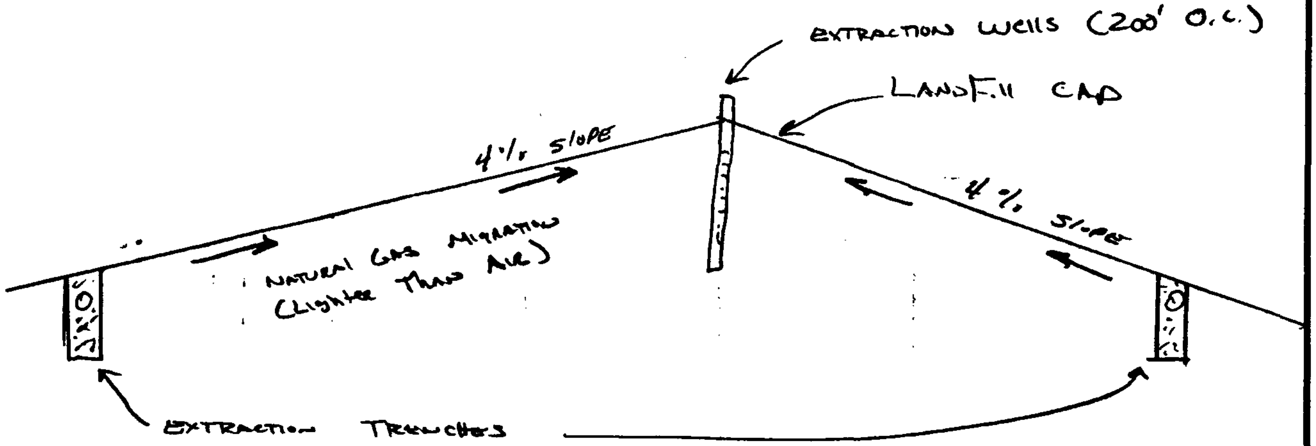
TOTAL FLOW RATE FROM WELLS, BASED ON THEORETICAL RADIUS OF INFLUENCE, IS APPROX. 560 cfm. TOTAL FLOW RATE APPROX 1100 cfm. ADDITIONAL 550 cfm NEEDS TO BE COLLECTED.

THE EXTRACTION TRENCHES WILL REMOVE A PORTION OF THIS. THE EXTRACTION TRENCHES WILL ALSO PREVENT LATERAL MIGRATION OF THE GAS OFFSITE.

THE COMPUTATIONS ASSUME A THEORETICAL CYLINDER OF INFLUENCE. IN ACTUALITY, GAS WILL BE MIGRATING NATURAL TO THE PEAK OF THE LANDFILL WHICH IS WHERE THE EXTRACTION WELLS ARE LOCATED.

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump SuperFund Site		SHEET NO. 10	OF
ITEM LFG Vent Design		BY RDT	DATE 3/96
		CHKD. BY	DATE

TYP. Schematic of System:



CONSEQUENTLY, THE WELLS WILL BE DRAWING GAS FROM A GREATER AREA THAN INDICATED BY CALCULATIONS. THE WELLS & SYSTEM HAVE THE CAPABILITY TO HANDLE ADDITIONAL FLOWS.

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 11	OF 12
ITEM		BY RST	DATE 11/96
		CHKD. BY	DATE

Ref 1: Sowers George, (1973), "Settlement of Waste Disposal Fills," 8th Int. Conf. on Soil Mechanics & Foundation Eng., Moscow, USSR. 1973 pg 207 - 210.

Ref 2: Bagchi, Amalendu, (1990), "Design, Construction, & Monitoring, of Sanitary Landfill," John Wiley, New York.

3. Stecker, Phillip, (1989), "Active Landfill gas Recovery Systems," University of Wisconsin Sanitary Landfill Leachate and Gas Management Seminar, Madison, Wisconsin December 4-7, 1989.

4. Farquhar, Graham J. (1989), "Factors influencing Landfill Gas Recovery," University of Wisconsin Sanitary Landfill Leachate & Gas Management Seminar, Madison, Wisconsin, Dec 4-7, 1989.

5. Ham, Robert K, (1989), "Landfill Gas Generation: Compositions, Quantities, Field Test Procedures & Uncertainty," University of Wisconsin Sanitary Landfill Leachate & Gas Management Seminar, Madison, Wisconsin, Dec 4-7, 1989.

6. Ham, Robert K, Barlaz, Morton A., (1987) "Measurement and Prediction of Landfill Gas Quality & Quantity," ISWA International Symposium, "Process, Technology, & Env. Impact of Sanitary Landfill," Cagliari, Sardinia, Italy Oct 20-23, 1987.

7. Pohland, Frederick G, Harper, Stephen R., "Critical Review & Summary of Leachate & Gas Production From Landfills," EPA/600/2-86/073. U.S. Env. Prot. Agency, Cincinnati, Ohio, 1986

8. Landva, Arvin O., Clark, Jack I, "Geotechnics of Waste Fills," Geotechnics of Waste Fill - Theory & Practice, ASTM STP 1070, American Society for Testing & Materials, Philadelphia, Pennsylvania, 1990.

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 12	OF 12
ITEM		BY RST	DATE 11/96
		CHKD. BY	DATE

✓ 9. Farquhar, Grahame J. (1989). "Sanitary Landfill Chemical & Biological Processes," University of Wisconsin Sanitary Landfill Leachate & Gas Management Seminar, Madison, Wisconsin, Dec. 4-7, 1989.

✓ 10. EMCON Associates (1980). "Methane Generation & Recovery from Landfills," Ann Arbor Science, Ann Arbor, Michigan

11. ETL 1110-1-160 Landfill Off-Gas Collection & Treatment Systems, USACE, 1995

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site	SHEET NO. 1 OF 5	
ITEM Foundation Layer - Gradation -	BY RDT	DATE 2/10/98
	CHKD. BY	DATE

∴ Size Foundation Layer Soil to Permit Gas Flow toward Collection Trenches.

According to ETL 110-1-160

"Most clean, free-draining sands and gravels placed in a relatively dry condition function adequately for gas collection & conveyance purposes. As a general rule of thumb, those soils which function best for LFG systems contain less than 6 percent by weight passing the No. 200 sieve and have a hydraulic conductivity (k) of greater than 10^{-3} cm/s. Soils which contain higher fractions of fines may function adequately during initial phases of the operation, but experience has shown these soils are more susceptible to clogging as a result of biological activity and saturation from the leachate."

∴ Typical commonly Available Gradations

ASTM C-33 (Fine Aggregate)		AASHTO M-6-93 (Fine Aggregate)
Sieve	Percent Passing	Percent Passing
3/8	100	100
No. 4	95 to 100	95 to 100
No. 8	80 to 100	—
No. 16	50 to 85	45 to 80
No. 30	25 to 60	—
No 50	10 to 30	10 to 30
No. 100	2 to 10	2 to 10

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 2	OF 5
ITEM Foundation Layer - Gradation		BY RJT	DATE 2/10/98
		CHKD. BY	DATE

AASHTO M 29-88

Sieve	% Passing	% Passing
3/8	100	100
No. 4	95 to 100	80-100
No. 8	70 to 100	65-100
No. 16	40 to 80	40 to 80
No. 30	20 to 65	20-65
No. 50	7 to 40	7-40
No. 100	2 to 20	2-20
No. 200	0 to 10	0-10
	Grade No. 7	Grade No. 4

Local Supplier, Fidler Inc, Produces Material which Meets ASTM C-33 Requirements. (See Attachment)

⇒ Foundation Layer Gradation (See Attached)

Sieve	% Passing
1/2	100
3/8	80-100
No. 8	55-100
No. 16	30-86
No. 30	20-65
No. 50	5-40
No. 200	0-10

This Gradation will Allow Several Typical ASTM or AASHTO Gradations to Be Used. In Addition, Some On-Site Borrow Material Will Meet the Gradation.

∴ Check Hydraulic Conductivity Using Hazens Eq.

$K = C D_{10}^2$

K = Hydraulic Conductivity
C = Constant Varies From 1 to 1.5
D_{10} = effective grain size (mm)

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 3	OF 5
ITEM Foundation Layer – Gradation		BY RST	DATE 2/10/98
		CHKD. BY	DATE

$K = CD_{10}^2$ $C = 1.0$

$D_{10} \approx 0.4$ TO 0.07 mm

$k = (1)(0.4)^2 = 0.16 = 1.6 \times 10^{-1}$ cm/s O.K

$k = (1)(0.07)^2 = .0049 = 4.9 \times 10^{-3}$ cm/s O.K

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★ U.S. GOVERNMENT PRINTING OFFICE: 1988-787-346

4/5

Fidler, Inc.

TOM ATKINS
QUALITY CONTROL

1700 EGBERT AVENUE • P.O. BOX 99
GOSHEN, INDIANA 46526 • (219) 533-0415
FAX 534-4528

…VE ANALYSIS

DATE 11/6/95

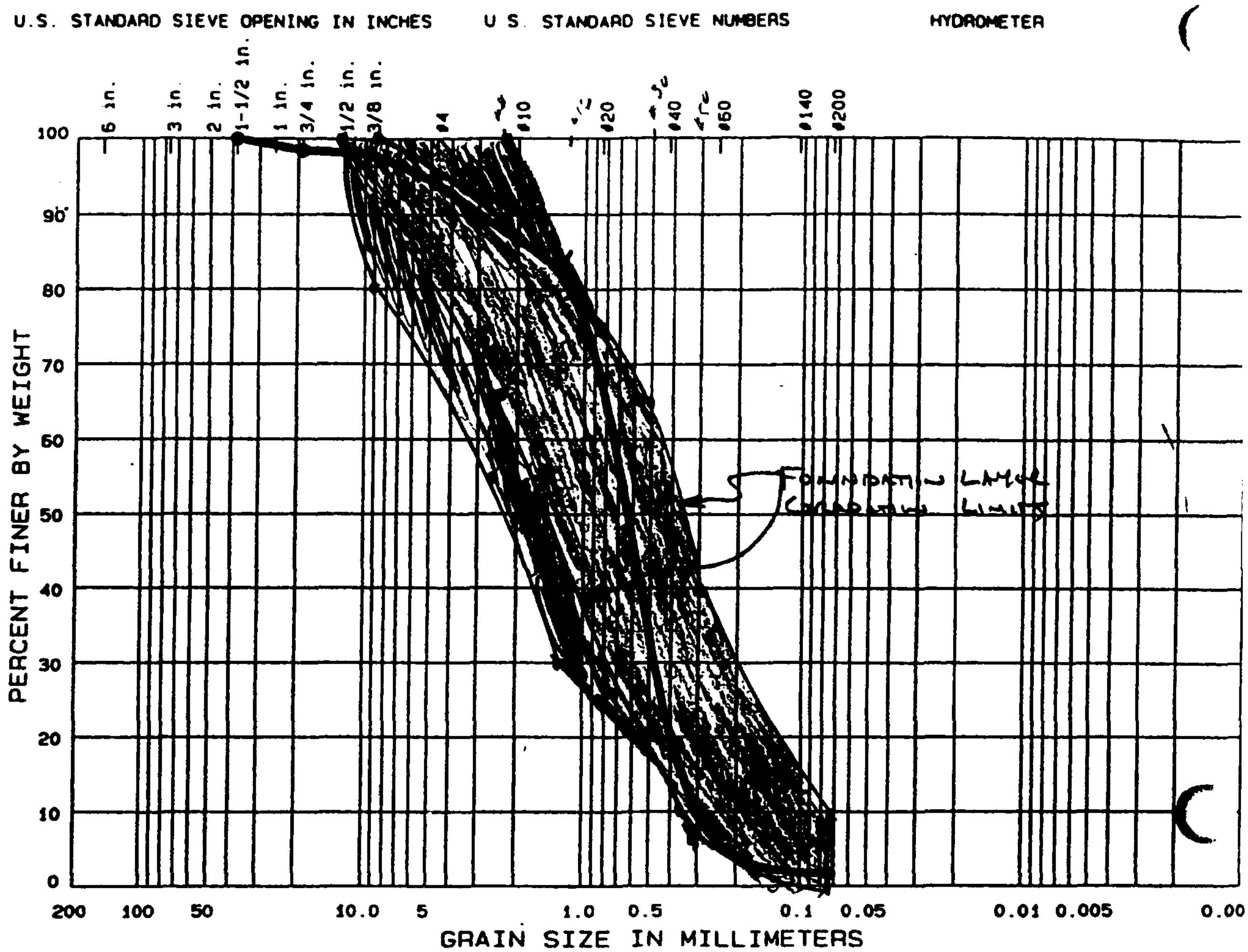
BY Jeff

AGG. SIZE ASTM C33 Concrete sand [redacted]

SCREEN SIZE		WEIGHT PASS	% PASS	SPECS	REMARKS
2"					
1½"					
1"					
3/4"					
1/2"					
3/8"		553.8		100%	
#4	1.	553.7	100	95/100	
#8	40.5	513.2	92.7	80/100	7.3
#16	81.6	431.6	77.9	50/85	22.1
#30	186.5	245.1	44.3	25/60	55.7
#50	171.3	73.8	13.3	5/30	86.7
#100	68.2	5.6	1	0/10	99
#200				0/3	270.8

A-480

5/5



% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
● 0.0	5.8	92.4	1.8

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	WT 112A						1.02	2.4

CLASSIFICATION

● SAND, SP

W.O. No. HSS
Req. No. ENE 5712
Contract No.

Remarks:

Project HIMCO Superfund Site

Lab No. 3584

Area

A-49E

Boring No. WT 112A

Date 10/27/95

C-5

GRADATION CURVES

CORPS OF ENGINEERS, MISSOURI RIVER DIVISION LAB
420 SOUTH 18th STREET - OMAHA, NE 68102-2586

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site		SHEET NO. 1	OF 1
ITEM Settlement Analysis		BY RJT	DATE 9/11/95
		CHKD. BY	DATE

METHOD

THE METHOD WHICH WAS USED TO ESTIMATE SETTLEMENT WAS BASED ON A PAPER BY GEORGE SOWERS, "SETTLEMENT OF WASTE DISPOSAL FILLS" PRESENTED IN 1973 AT THE PROCEEDINGS, 8th INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING, 1973, MOSCOW.

SITE DATA

LANDFILLING AT THE HIMCO DUMP SITE WAS INITIATED IN APPROX. 1960 & CEASED IN 1976. WASTES AT THE LANDFILL INCLUDE CALCIUM SULFATE, DEMOLITION/CONSTRUCTION DEBRIS, HOUSEHOLD REFUSE, AND INDUSTRIAL & HOSPITAL WASTES. (RI/FS REPORT) REFER TO TRENCH LOGS FOR TYPICAL MAKEUP OF WASTE SECTION IN SELECTED AREAS.

EQUATIONS / CALCULATIONS

SEE ATTACHED SHEETS FOR SETTLEMENT CALCULATIONS AND EQUATION DEFINITIONS.

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site	SHEET NO. 1	OF 2
ITEM Summary of Settlement Calcs	BY RJT	DATE 3/96
	CHKD. BY	DATE

STATION	TOTAL PRIMARY SETTLEMENT (IN)	PRIMARY SETTLEMENT AFTER CONSTRUCTION (IN)	SECONDARY SETTLEMENT AFTER CONST. (IN)	SOWERS METHOD TOTAL CAP SETTLEMENT (IN)
5+00	12	1	3	4.0
8+00	15	1.5	3.8	5.3
10+00	17	1.7	4.3	6.0
21+00	18	1.8	4.7	6.5

* USING SOWERS METHOD.

** CONCLUSION: AT THE ℄ of the CAP, the MAXIMUM ANTICIPATED Settlement AFTER completion of the CAP is ABOUT 6 inches. AND COULD BE LESS.

THERE WILL BE LITTLE SETTLEMENT AROUND THE BOUNDARIES of THE LANDFILL DUE TO A CUT SITUATION.

CONSEQUENTLY, the DIFFERENTIAL Settlement AND REDUCTION IN GRADE ARE VERY SMALL. (SEE ATTACHED)

MRO Form 1550, 1 DEC 83

☆ U.S.G.P.O.: 1995-657-136

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Settlement Calcs		SHEET NO. 2	OF 2
ITEM Summary of Results		BY RDT	DATE 3/96
		CHKD. BY	DATE

∴ FINAL SLOPE GRADES

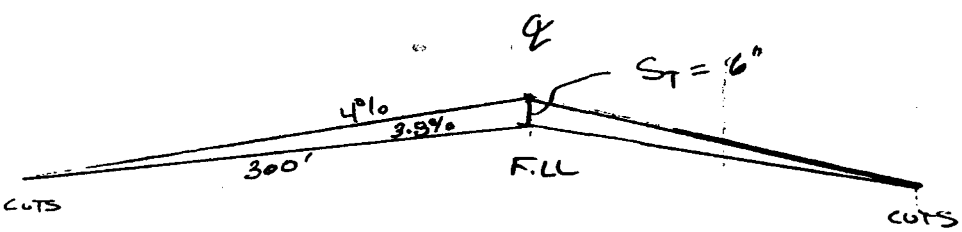
Initial Slope = 4%

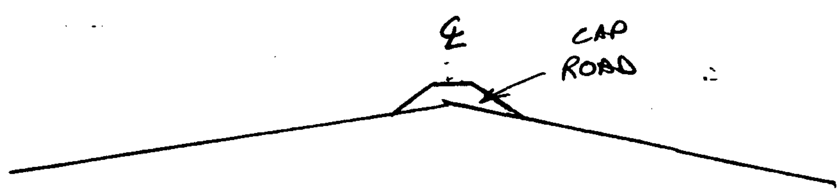
Slope LENGTH ≈ 300'

Post Closure Settlement = 6"

$$* \text{Final Grade} = 4 - \left(\frac{6/12}{300}\right)(100) = 3.8\%$$

* DOES NOT TAKE INTO ACCOUNT THE ROAD w/ STEEPER SLOPES.





OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HD SS		SHEET NO. 1	OF 1
ITEM DATA FOR SETTLEMENT Calcs		BY RST	DATE 3/96
		CHKD. BY	DATE

℄ Ridge STA	℄ Ridge Random/Trash Fill (ft)	℄ Ridge Cover Mat. Thick (ft)	℄ Ridge Approx. Waste Thick Ex. (ft)	℄ Road Station
2+00	3	3	10 (1)	N/A
3+00	3	3		N/A
4+00	4	3		N/A
5+00	5	5.5		≃ Same
6+00	7			
7+00	8			
8+00	8		15	
9+00	10			
10+00	11			
11+00	10			
12+00	11			
13+00	16	CREST ROAD		
14+00	10			
15+00	11			
16+00	9			
17+00	8			
18+00	9			
19+00	8			
20+00	8			
21+00	13	5.5		
22+00	10	3		N/A
23+00	5	3		N/A
24+00	1	3		N/A

(1) Approx. Very little data on refuse thickness available

	Cap	Road
Cover Materials:	12" Foundation	12" Foundation
	18" Select Fill	4' Select Fill
	6" Topsoil	6" Topsoil
	3'	5.5'

MRO Form 1550, 1 DEC 83

☆ U.S.G.P.O.: 1993-556-577

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Superfund Site		SHEET NO. 1	OF 6
ITEM Typical Settlement Calc.		BY RST	DATE 3/96
		CHKD. BY	DATE

STATION 51+00

℄ of Final Cover

Conceptual Model:

Depth	Layer	γ	e_o	C_c	α
0	Cover Soils	$\gamma = 110$ psf			
5.5	New Waste	$\gamma = 75$ psf	$e_o = 1.3$	$C_c = 0.50$	$\alpha = 0.08$
10.5	Old Waste	$\gamma = 75$ psf	$e_o = 1.3$	$C_c = 0.50$	$\alpha = 0.08$
20.5	Foundation Sands				

* Refer to Waste Properties Sheet For Derivation of Properties

A-1 Calculate Longterm (Secondary) Settlement of "Old Waste" Layer From 1976 to 1996

∴ Assume Initial Waste Layer Thickness = 11 ft.

$$\Delta_{76-96} = \frac{\alpha \, H_{waste}}{1+e_o} \operatorname{Log}\left(t_2/t_1\right)$$

$t_2 = 20$ yr $= 240$ months
$t_1 = 1$ month

$$= \frac{0.08(11)}{1+1.3} \operatorname{Log}\left(240/1\right)$$

$\Delta_{76-96} = 0.93$ ft $= 11$ inches

MRO Form 1550, 1 DEC 83

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT Himco Dump Super Fund Site		SHEET NO. 2	OF 6
ITEM TM. Settlement Calc.		BY RJT	DATE 3/9C
		CHKD. BY	DATE

B) Calculate additional settlement in old waste layer due to increase in overburden stresses from waste/Fill placement

$$\Delta = \frac{C_c}{1+e_0} (H_{waste}) \operatorname{Log} \left(\frac{P+\Delta P}{P} \right)$$

Use $e_0 = 1.3$ Neglect reduction in void ratio due to long term settlement because of general assumptions used for waste properties

$H_{waste} \simeq 10'$

$$P_0 = 5(75) = 375 \text{ psf}$$
$$\Delta P = 5.5(10) + 5(75) = 980 \text{ psf}$$

$$\Delta = \frac{0.26}{1+1.3} (10) \operatorname{Log} \left(\frac{980+375}{375} \right) = 0.63 \text{ ft} = 7.5''$$

NOTE 1: This primary settlement will occur rapidly & simultaneously w/ construction. Consequently, the liner will not be displaced by the amount of settlement indicated. Actual settlement after completion of the cap due to the increase in overburden stresses will be on the order of several inches.

To accomodate settlement during construction, the contractor will monitor grades and place additional material as req'd.

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT	HDSS	SHEET NO. 3	OF 6
ITEM	TYP. SETTLEMENT CALC	BY RJT	DATE 3/96
		CHKD. BY	DATE

C.) Calculate ADDITIONAL LONG TERM (SECONDARY) CONSOLIDATION of THE OLD WASTE LAYER, DURING POST CLOSURE (1996-2026)

$\Delta_{76} - \Delta_{96} = 11$ inches (PREVIOUS CALC)

NEGLECT COMPRESSION OF WASTE DUE TO PRIMARY CONSOLIDATION.

$$\Delta_{76-2026} = \frac{\alpha}{1+e_0} H \log\left(t_2/t_1\right)$$

$$= \frac{0.08}{2.3}(11)\log\left(\frac{600}{1}\right)$$

$t_2 = 600$ month
$t_1 = 1$ month

$= 1.06$ ft $\cong 13$ inches

∴ TOTAL ADDITIONAL SETTLEMENT OF "OLD WASTE" DUE TO SECONDARY CONSOLIDATION FROM 1996-2026

$$\Delta_{96-2026} = 13 - 11 = 2 \text{ inches}$$

∴ CONCLUSION = 2 inches of ADDITIONAL SETTLEMENT OF THE OLD WASTE CAN BE EXPECTED AFTER FINAL CLOSURE

: DOES NOT INCLUDE PRIMARY SETTLEMENT AFTER CLOSURE

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT N.D.S.S.		SHEET NO. 4	OF 6
ITEM TYP. SETTLEMENT Calc		BY RDT	DATE 3/96
		CHKD. BY	DATE

D) Calculate Primary Settlement in "New Waste" Layer due to Cover System Overburden Stresses.

$$\Delta = \frac{C_c}{1+e_0}(H_w) \text{Log}\left(\frac{P_0+\Delta P}{P_0}\right)$$

$P_0 = 2.5(75) = 187.5$ psf

$\Delta P = 5.5(110) = 605$ psf

$$\Delta = \frac{0.26}{1+1.3}(5) \text{Log}\left(\frac{188+605}{188}\right)$$

$\Delta = 0.35' = \underline{\underline{4}}''$ ←

See Note 1 on Previous Page

E) Calculate Long Term Settlement of "New Waste" Layer: Since waste is old & has undergone decomposition. Assume same time frames as for old waste layer (i.e. 1976 to 1996 & 1996 to 2026). Neglect compression of waste thickness from primary consolidation.

$$\Delta_{1976-96} = \frac{\alpha}{1+e_0} H_w \text{ Log}\left(t_2/t_1\right)$$

$t_2 = 240$ month
$t_1 = 1$ month

$$= \frac{0.08}{2.3}(5) \text{Log}\left(240/1\right) = 0.41' \approx 5''$$

$\Delta_{76-96} = 5''$

MRO Form 1550, 1 DEC 83

☆U.S.G.P.O.: 1995-657-136

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT H.O.S.S.		SHEET NO. 5	OF 6
ITEM TYP. SETTLEMENT CALC		BY	DATE
		CHKD. BY	DATE

$$\Delta_{76-26} = \frac{0.08}{2.3}(5)\,\mathrm{Log}\,(600/1) = 0.48'$$

$t_2 = 600$ m
$t_1 = 1$ m

$= 0.48' = 6''$

SO:

$\Delta_{96-26} = 6-5'' = 1''$ ←

E) Consolidation of Cover Soils:

∴ The cover materials will be consolidated during construction & no additional consolidation of those soils is expected.

- Soils will be placed in thin layers & compacted.
- Random & Select Fills will likely be sandy. Consequently, they will be immediately consolidated.

F) Consolidation of Foundation Soils:

∴ Foundation soils will consolidate immediately w/ the application of load. (Sands). Consequently, no settlement of the cap from this source is anticipated.

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HOSS		SHEET NO. 6	OF 6
ITEM Top. Settlement Calc		BY RDT	DATE 3/96
		CHKD. BY	DATE

6) Summary of Results

∴ Total Additional Long Term Settlement of Refuse [cases A, C, & E]

$\Delta T = 2" + 1" = 3"$

$\Delta T = 3$ inches

LONG TERM

∴ Total Primary Settlement of Refuse [case B & D]

$\Delta T = 15" + 8" = 23"$

$\Delta T = 12$ inches

PRIMARY

∴ Total Primary Settlement At Completion of cap

Approx 10% of ΔT_p

$\Delta T_p = 12(0.1) = 1.2" \approx 1"$

$\Delta T_{primary} = 1"$

After Construction

∴ Total Expected Settlement of Final Cover at ℄ STA 5+00

$S_T = 3+1" = 4"$

STA 5+00 ℄ ACCESS ROAD
RIDGE of CAP

	US ARMY CORPS OF ENGINEERS			
	HIMCO DUMP SUPERFUND SITE			
	SETTLEMENT CALCULATIONS FOR LANDFILL COVER			
	Reference: Sowers, George P., "Settlement of Waste Disposal Fills", 1973, Proceedings,			
	Eighth International Conference on Soil Mechanics and Foundation Engineering, Moscow, pp.207-210			
Variable Definitions	Svo'	existing effective overburden, Sigma vo'		
	dSvo'	effective change in stress, delta Sigma vo'		
	eo	initial void ratio		
	e	void ratio		
	delta e	change in void ratio		
	Cc coef.	0.15 to 0.55, see Primary settlement equations below		
	Cc	(Cc coef)(eo)		
	Hfo	initial height of fill		
	Hf	height of fill		
	dHf	change in height of fill (delta Hf)		
	Cumul dHf	Cumulatative change in height of fill, i.e. settlement		
	t1	starting time for increment		
	t2	ending time for increment		
	alpha coef.	0.03 to 0.09, see Secondary settlement equations below		
	alpha	(alpha coef)(e)		
	NA	Not Applicable		
Primary Settlement	dHf = [(Hf)(-delta e)]/(1 + eo)			
		delta e = -(Cc)(log10[(Svo' + dSvo')/Svo'])		
			Cc = 0.15eo for low organic fills	
			Cc = 0.55eo for high organic fills	
			Svo' (Sigma vo') = existing effective overburden	
			dSvo' (delta Sigma vo') = effective change in stress	
Secondary Settlement	dHf = (Hf)(delta e)/(1+eo)			
		delta e = -(alpha)log(t2/t1)		
			alpha = 0.03e for conditions unfavorable to decomposition	
			alpha = 0.09e for conditions favorable to decomposition	
			t1 = number of months after completion	
			t2 = number of months after completion	

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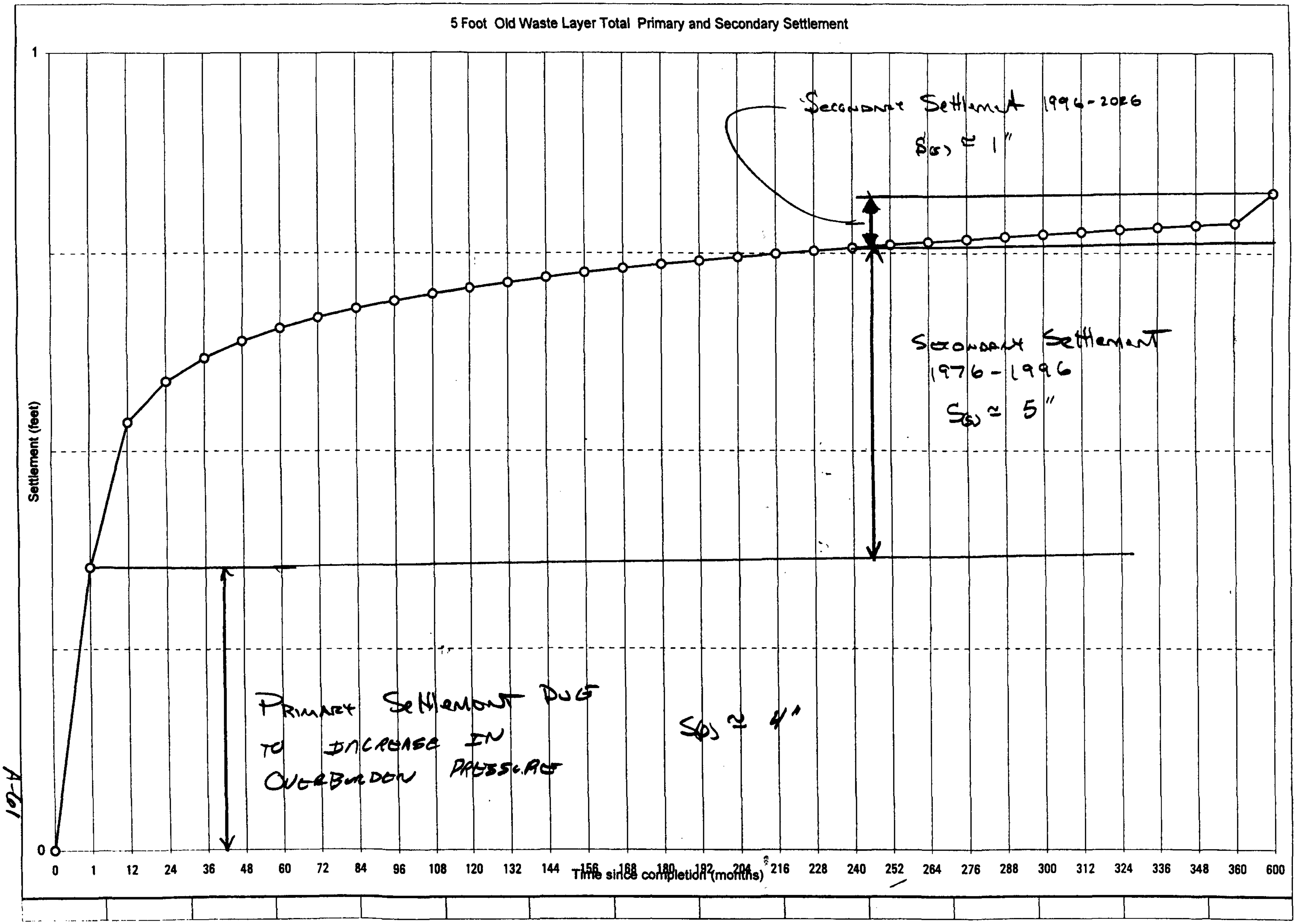
CONDITION:	Settlement of 5 Foot Thick Old Waste Layer, Primary and Secondary								
Primary	Svo' (psf)	dSvo' (psf)	log ((Svo'+dSvo')/dSvo')	eo(void ratio)	Cc coef.	delta e	Hfo(feet)		
Assumed values ==>	*188*	*605*		*1.30*	*0.20*	0.0000	*5.00*		
			0.6251		Cc = 0.26	-0.1625			
Secondary					alpha coef.				
Assumed values ==>					*0.06*				
	t1	t2		e			Hf	dHf	Cumul dHf
	(months)	(months)	log (t2/t1)	(void ratio)	alpha	delta e	(feet)	(feet)	(feet)
	NA	0	NA	NA	NA	NA	NA	NA	0.00
Primary ==>	0	1	NA	1.30	NA	-0.1625	5.00	0.353	0.35
Secondary	1	12	1.0792	1.14	0.08	-0.0842	4.65	0.183	0.54
"	12	24	0.3010	1.05	0.08	-0.0235	4.46	0.051	0.59
"	24	36	0.1761	1.03	0.08	-0.0137	4.41	0.030	0.62
"	36	48	0.1249	1.02	0.08	-0.0097	4.38	0.021	0.64
"	48	60	0.0969	1.01	0.08	-0.0076	4.36	0.016	0.65
"	60	72	0.0792	1.00	0.08	-0.0062	4.35	0.013	0.67
"	72	84	0.0669	0.99	0.08	-0.0052	4.33	0.011	0.68
"	84	96	0.0580	0.99	0.08	-0.0045	4.32	0.010	0.69
"	96	108	0.0512	0.98	0.08	-0.0040	4.31	0.009	0.70
"	108	120	0.0458	0.98	0.08	-0.0036	4.30	0.008	0.71
"	120	132	0.0414	0.98	0.08	-0.0032	4.29	0.007	0.71
"	132	144	0.0378	0.97	0.08	-0.0029	4.29	0.006	0.72
"	144	156	0.0348	0.97	0.08	-0.0027	4.28	0.006	0.73
"	156	168	0.0322	0.97	0.08	-0.0025	4.27	0.005	0.73
"	168	180	0.0300	0.96	0.08	-0.0023	4.27	0.005	0.74
"	180	192	0.0280	0.96	0.08	-0.0022	4.26	0.005	0.74
"	192	204	0.0263	0.96	0.08	-0.0021	4.26	0.004	0.74
"	204	216	0.0248	0.96	0.08	-0.0019	4.26	0.004	0.75
"	216	228	0.0235	0.96	0.08	-0.0018	4.25	0.004	0.75
"	228	240	0.0223	0.95	0.08	-0.0017	4.25	0.004	0.76
"	240	252	0.0212	0.95	0.08	-0.0017	4.24	0.004	0.76
"	252	264	0.0202	0.95	0.08	-0.0016	4.24	0.003	0.76
"	264	276	0.0193	0.95	0.08	-0.0015	4.24	0.003	0.77
"	276	288	0.0185	0.95	0.08	-0.0014	4.23	0.003	0.77
"	288	300	0.0177	0.95	0.08	-0.0014	4.23	0.003	0.77
"	300	312	0.0170	0.94	0.08	-0.0013	4.23	0.003	0.78
"	312	324	0.0164	0.94	0.08	-0.0013	4.22	0.003	0.78
"	324	336	0.0158	0.94	0.08	-0.0012	4.22	0.003	0.78
"	336	348	0.0152	0.94	0.08	-0.0012	4.22	0.003	0.78
"	348	360	0.0147	0.94	.08	-0.0011	4.22	0.002	0.79
"	360	600	0.2218	0.94	0.08	-0.0173	4.21	0.038	0.82

TYPICAL TIME VS. SETTLEMENT PLOT



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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site	SHEET NO. 1 OF 3	
ITEM Settlement Calcs, II	BY RJT	DATE 3/96
	CHKD. BY	DATE

SUMMARY of RESULTS USING EDIL, RANQUETTE, & WOELLNER

STATION	SETTLEMENT of NEW WASTE @ 1 YR (IN)	SETTLEMENT of NEW WASTE @ 30 YR (IN)	SETTLEMENT of OLD WASTE @ 1 YR (IN)	SETTLEMENT of OLD WASTE @ 31 YR (IN)	TOTAL EXPECTED SETTLEMENT AFTER t = 1 YR (CONSTRUCTION) (IN)
5+00	0.33	0.96	1.07	3.10	2.7
8+00	0.63	1.533	1.98	5.73	4.8
10+00	0.73	2.11	2.35	6.80	5.8
21+00	0.86	2.49	2.59	7.51	6.5"

* ASSUMES WASTE PLACED IN 1ST YEAR, TOTAL SETTLEMENT @ T=29 YR IN POST CLOSURE.

FINAL SETTLEMENT #'S ARE COMPARABLE TO SOWERS

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Nimco Dump Superfund Site	SHEET NO. 2	OF 3
ITEM Settlement Calcs II	BY RJT	DATE 3/96
	CHKD. BY	DATE

∴ Settlement Calcs using Procedures Presented By Edil, Ranguette, & Wuellner (1991)

For Station 8+00 Cap ℄

Gov. Eq.

$$S(t) = H \Delta Q \{a + b(1 - \exp[-(\lambda/b)t]\}$$

See Attached Sheets For Definition of Variables

where: 1 kip = 47.8 Pa

$H = 15$ ft.
$\Delta Q = 1.205$ ksf (See Sowers Method)
$a = 0.0024$ /ksf (5×10^{-5}/kPa)
$b = 0.024$ /ksf (5×10^{-4}/kPa)
$\lambda/b = 0.0009$ / day (9×10^{-4} / day)
$t = 10{,}950$ days = 30 yrs. (Post Closure)

(* See Attached Sheet)

$$S(t) = 15\text{ ft}(1.205\text{ ksf})\left\{.0024 + 0.024\left(1 - \exp[-(0.0009)10950]\right)\right\}$$

$S(t) = 0.48$ ft $= 5.72$ inches ✓

Total Settlement in Layer For 30 yrs

MRO Form 1550, 1 DEC 83

☆ U.S.G.P.O.: 1993-556-577

TABLE 2 -- EMPIRICAL MODEL PARAMETERS

Platform Number	Applied Stress (kPa)	Average Strain (%/yr)	Gibson & Lo a (1/kPa)	Gibson & Lo b (1/kPa)	Gibson & Lo λ/b (1/day)	Power Creep m (1/kPa)	Power Creep n (t_r = 1 day)
SITE A							
1	77.21	2.37	4.42e-5	1.62e-3	5.60e-4	5.48e-6	0.702
2	54.09	4.59	1.40e-4	5.87e-3	4.00e-3	5.75e-6	0.862
3	53.58	7.51	3.52e-4	2.18e-3	3.10e-3	1.38e-4	0.438
4	45.00	6.81	1.78e-4	4.58e-3	1.20e-3	1.18e-5	0.850
15	146.27	0.83	5.32e-7	1.77e-3	9.20e-5	7.52e-8	1.131
16	134.12	1.42	6.11e-6	1.13e-3	2.30e-4	9.00e-8	1.170
7	195.65	3.14	4.10e-6	5.49e-4	1.10e-4	1.61e-6	0.804
9	200.16	2.01	5.11e-7	1.24e-3	2.50e-4	3.15e-7	0.980
8	276.40	5.50	7.76e-5	6.01e-4	9.40e-4	3.10e-6	0.744
10	227.76	4.84	8.35e-5	3.54e-4	2.40e-3	3.40e-6	0.746
11	168.01	13.58	2.12e-4	1.00e-4	1.60e-3	1.67e-5	0.619
12	195.32	4.74	1.99e-4	5.05e-4	7.70e-4	5.48e-5	0.297
13	219.07	5.89	2.30e-4	3.75e-4	1.10e-3	5.89e-5	0.302
14	130.12	8.98	5.34e-5	8.40e-4	2.70e-3	1.30e-5	0.670
17	300.29	9.82	2.86e-5	4.74e-4	4.30e-3	1.16e-6	1.005
SITE B							
S-4	59.88	0.50	3.60e-6	4.10e-4	6.00e-4	7.85e-7	0.779
S-5	59.88	1.17	2.80e-5	5.60e-4	9.70e-4	2.25e-6	0.759
S-6	146.10	5.17	1.10e-5	5.70e-4	3.30e-3	8.83e-6	0.648
SITE C							
84-2	79.42	0.90	1.00e-4	4.70e-4	9.70e-4	6.48e-5	0.264
84-3	79.42	0.48	1.30e-5	3.50e-4	8.40e-4	1.10e-5	0.409
84-4	71.66	0.83	1.20e-4	4.30e-4	1.20e-3	5.14e-5	0.304
84-5	102.79	0.68	5.20e-5	2.50e-4	1.40e-3	2.75e-5	0.314
84-6	79.42	0.72	2.00e-5	5.40e-4	8.40e-4	1.40e-5	0.465
84-7	71.66	0.79	4.90e-5	3.80e-4	1.40e-3	1.67e-5	0.443
SITE D							
SP1	50.97	8.33	7.50e-5	1.90e-3	4.00e-3	4.69e-5	0.593
SP2	50.97	14.00	8.00e-5	4.90e-3	1.90e-3	4.85e-5	0.666
SP3	50.97	8.44	3.80e-4	2.20e-3	2.00e-3	8.57e-5	0.486

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Selected Values were within Range of Values found at Sites B & C

Power Creep Law Parameters

The two empirical parameters of the power creep law derived for the four sites are given in Table 2. These parameters did not indicate any discernible trends with the respect to applied stress or average strain in each site within the range of variation of these factors. Reference compressibility, m has an average value of about 2.5 x 10^{-5} 1/kPa and it is about 1.7 times higher for old refuse (3.4 x 10^{-5} 1/kPa) than fresh refuse (2.0 x 10^{-5} 1/kPa). It shows no discernible patterns with respect to placement conditions of the refuse. However, it is quite variable, especially in Sites A and B. Rate of compression, n has an average of 0.65 and indicates some patterns with respect to age and placement conditions of the refuse. For instance, old relocated refuse from Site C that was compacted during placement had the lowest average n = 0.37 and, in general, fresh refuse had an average n value of nearly 1.5 times as that of old refuse. The variability of n is not as great as that of m; however, it is more variable in Site A than the other three sites.

COMPARISON OF THE MODELS

For Site A, the first year of data obtained was used to predict the amount of settlement that could be expected at the end of the data collection period which was about two years. The results obtained using both models are compared with the actual measurements in Table 3. The Gibson and Lo model predicted the amount of settlement at the end of two years within 2 to 18% of the actual settlement that occurred for minimal filling and 4 to 21% for active filling. The power creep law predictions for the same conditions were 0 to 6% and 0 to 14%, respectively.

TABLE 3 -- COMPARISON OF PREDICTED SETTLEMENT

Platform Number	Settlement (m) Actual	Settlement (m) Gibson & Lo	Settlement (m) Power Creep	Percent Diviation (%) Gibson & Lo	Percent Diviation (%) Power Creep
Minimal Filling					
1	0.52	0.43	0.53	-17	2
2	0.59	0.59	0.59	0	0
3	1.11	1.09	1.06	-2	-4
4	1.19	1.23	1.24	4	5
7	1.88	1.54	2.00	-18	6
Active Filling					
8	3.34	3.19	3.38	-4	1
10	2.99	2.93	3.18	-2	6
12	1.94	1.91	1.94	-1	0
13	2.03	2.00	1.97	-2	-3
14	2.95	2.32	2.53	-21	-14

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U.S. Army Corps of Engineers, Omaha District

Project:	Himco Dump Superfund Site	Location:	Elkhart, Indiana
Item:	Settlement Calculations for Landfill Cover	Date:	Mar-96
		By:	R. Taylor

CASE: 5+00

Note: Calculation of Settlement Usig Procedures Presented by Edil, Ranguette, & Wuellner (1991)

Governing Equation: S(t)=HdeltaQ{a+b(1-exp[-(y/b)t])}

Where
S(t)=Total primary and secondary settlement
H=Initial height of refuse
deltaQ=Increase in compressive stress at top of refuse
a=Primary compressibility parameter
b=Secondary compressibility factor
y/b=Rate of secondary compression
t=Time since load application

Trial No. 1 ***Notes:*** ***New Waste Layer***

Input Data:

H=	5	ft	
deltaQ=	0.605	ksf	
a=	0.0024	/ksf	
b=	0.024	/ksf	
y/b=	0.0009	/day	
t=	10,950	days	30 years

Output Data: **S(t)= 0.96 inches for time= 30 years**

Trial No. 2 ***Notes:*** ***Old Waste Layer***

Input Data:

H=	10	ft
deltaQ=	0.98	ksf
a=	0.0024	/ksf
b=	0.024	/ksf
y/b=	0.0009	/day
t=	18250	days

Output Data: **S(t)= 3.10 inches for time= 50 years**

U.S. Army Corps of Engineers, Omaha District

Project: Himco Dump Superfund Site　　Location: Elkhart, Indiana

Item: Settlement Calculations for Landfill Cover　　Date: Mar-96
By: R. Taylor

CASE: 5+00

Note: Calculation of Settlement Usig Procedures Presented by Edil, Ranguette, & Wuellner (1991)

Governing Equation: S(t)=HdeltaQ{a+b(1-exp[-(y/b)t])}

Where
S(t)=Total primary and secondary settlement
H=Initial height of refuse
deltaQ=Increase in compressive stress at top of refuse
a=Primary compressibility parameter
b=Secondary compressibility factor
y/b=Rate of secondary compression
t=Time since load application

Trial No. 1　　***Notes:*** ***New Waste Layer***

Input Data:

H=	5	ft	
deltaQ=	0.605	ksf	
a=	0.0024	/ksf	
b=	0.024	/ksf	
y/b=	0.0009	/day	
t=	365	days	1 years

Output Data: **S(t)= 0.33 inches for time= 1 years**

Trial No. 2　　***Notes:*** ***Old Waste Layer***

Input Data:

H=	10	ft
deltaQ=	0.98	ksf
a=	0.0024	/ksf
b=	0.024	/ksf
y/b=	0.0009	/day
t=	365	days

Output Data: **S(t)= 1.07 inches for time= 1 years**

U.S. Army Corps of Engineers, Omaha District

Project: Himco Dump Superfund Site | Location: Elkhart, Indiana

Item: Settlement Calculations for Landfill Cover | Date: Mar-96
By: R. Taylor

CASE: 5+00

Note: Calculation of Settlement Usig Procedures Presented by Edil, Ranguette, & Wuellner (1991)

Governing Equation: S(t)=HdeltaQ{a+b(1-exp[-(y/b)t])}

Where
S(t)=Total primary and secondary settlement
H=Initial height of refuse
deltaQ=Increase in compressive stress at top of refuse
a=Primary compressibility parameter
b=Secondary compressibility factor
y/b=Rate of secondary compression
t=Time since load application

Trial No. 1 ***Notes:*** ***New Waste Layer***

Input Data:

H=	5	ft	
deltaQ=	0.605	ksf	
a=	0.0024	/ksf	
b=	0.024	/ksf	
y/b=	0.0009	/day	
t=	10,950	days	30 years

Output Data: **S(t)= 0.96 inches for time= 30 years**

Trial No. 2 ***Notes:*** ***Old Waste Layer***

Input Data:

H=	10	ft
deltaQ=	0.98	ksf
a=	0.0024	/ksf
b=	0.024	/ksf
y/b=	0.0009	/day
t=	10950	days

Output Data: **S(t)= 3.10 inches for time= 30 years**

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**             HELP MODEL VERSION 3.04a  (10 JULY 1995)                     **
**              DEVELOPED BY ENVIRONMENTAL LABORATORY                       **
**                USAE WATERWAYS EXPERIMENT STATION                         **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                 **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************
```

```
PRECIPITATION DATA FILE:      C:\HELP3\HIMCO1.D4
TEMPERATURE DATA FILE:        C:\HELP3\hIMCO1.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\HIMCO1.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\himco1.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\himco14.D10
OUTPUT DATA FILE:             C:\HELP3\himco14.OUT
```

SUMMARY OUTPUT FOR:
30-YEAR RUN
FOR
50 ACRE SITE

```
TIME:   9:28      DATE:   3/30/1996
```

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******************************************************************************

    TITLE:  HIMCO DUMP SUPERFUND SITE

******************************************************************************
```

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    NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
             COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                 LAYER  1
                                 --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   6
         THICKNESS                   =       6.00    INCHES
         POROSITY                    =       0.4530 VOL/VOL
         FIELD CAPACITY              =       0.1900 VOL/VOL
         WILTING POINT               =       0.0850 VOL/VOL
         INITIAL SOIL WATER CONTENT  =       0.3168 VOL/VOL
         EFFECTIVE SAT. HYD. COND.   =   0.720000011000E-03 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.30	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0112	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	55.0000000000	CM/SEC
SLOPE	=	4.00	PERCENT
DRAINAGE LENGTH	=	500.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 37

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999999000E-10	CM/SEC
FML PINHOLE DENSITY	=	4.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	3.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.20	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL

INITIAL SOIL WATER CONTENT = 0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.300000003000E-08 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM A USER-SPECIFIED CURVE NUMBER OF 74.0, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 500. FEET.

SCS RUNOFF CURVE NUMBER	=	74.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	50.000	ACRES
EVAPORATIVE ZONE DEPTH	=	14.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.152	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.054	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.654	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	4.575	INCHES
TOTAL INITIAL WATER	=	4.575	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
FORT WAYNE INDIANA

STATION LATITUDE	=	41.50	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	116	
END OF GROWING SEASON (JULIAN DATE)	=	289	
EVAPORATIVE ZONE DEPTH	=	14.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR FORT WAYNE INDIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.48	1.99	3.05	4.06	2.81	3.94
3.67	3.94	3.22	3.22	2.83	2.95

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR FORT WAYNE INDIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.20	26.40	36.00	48.50	59.10	68.80
72.50	70.90	64.20	53.20	40.30	29.10

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR FORT WAYNE INDIANA
AND STATION LATITUDE = 41.50 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
ECIPITATION						
OTALS	2.36	1.94	2.76	4.66	3.03	3.92
	3.63	3.50	3.06	2.76	2.65	3.25
STD. DEVIATIONS	0.93	1.02	1.16	1.44	1.20	1.64
	1.86	1.78	1.63	1.97	1.41	1.53
RUNOFF						
TOTALS	0.753	1.393	1.488	0.595	0.000	0.011
	0.004	0.011	0.005	0.025	0.004	0.472
STD. DEVIATIONS	0.870	1.156	1.106	1.227	0.000	0.033
	0.012	0.031	0.018	0.094	0.015	0.724
EVAPOTRANSPIRATION						
TOTALS	0.405	0.343	0.770	3.080	3.047	3.284
	3.125	2.414	2.440	1.547	0.882	0.542
STD. DEVIATIONS	0.119	0.100	0.463	0.886	1.074	1.304
	1.357	1.229	0.918	0.567	0.266	0.142
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.3456	0.1241	1.2104	2.1495	0.8914	0.6434
	0.6307	0.8437	0.7854	0.8897	0.9399	1.4570
STD. DEVIATIONS	0.5198	0.1918	1.1534	1.0622	0.3510	0.3682
	0.4427	0.7661	0.5411	1.0912	0.8394	1.1071

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0004	0.0002	0.0016	0.0029	0.0012	0.0009
	0.0008	0.0011	0.0011	0.0012	0.0013	0.0019
STD. DEVIATIONS	0.0007	0.0003	0.0015	0.0014	0.0005	0.0005
	0.0006	0.0010	0.0007	0.0014	0.0011	0.0014

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES		CU. FEET	PERCENT
PRECIPITATION	37.54	(5.019)	6813752.0	100.00
RUNOFF	4.760	(2.6986)	863859.06	12.678
EVAPOTRANSPIRATION	21.877	(3.4963)	3970686.75	58.275
LATERAL DRAINAGE COLLECTED FROM LAYER 3	10.91086	(2.84685)	1980320.370	29.06358
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00023	(0.00000)	42.198	0.00062
AVERAGE HEAD ON TOP OF LAYER 4	0.001	(0.000)		
CHANGE IN WATER STORAGE	-0.012	(0.9967)	-2136.55	-0.031

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.79	687885.000
RUNOFF	4.312	782708.4370
DRAINAGE COLLECTED FROM LAYER 3	1.74967	317565.59400
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000001	0.23141
AVERAGE HEAD ON TOP OF LAYER 4	0.070	
MAXIMUM HEAD ON TOP OF LAYER 4	0.139	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	5.7 FEET	
SNOW WATER	5.49	996739.4370
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.3825
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0467

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	1.0856	0.1809
2	2.9807	0.1656
3	0.0055	0.0182
4	0.0000	0.0000
5	0.1500	0.7500
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                 HELP MODEL VERSION 3.04a  (10 JULY 1995)                 **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
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PRECIPITATION DATA FILE:      C:\HELP3\himco2.D4
TEMPERATURE DATA FILE:        C:\HELP3\himco2.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\himco2.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\himco2.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\himco8.D10
OUTPUT DATA FILE:             C:\HELP3\himco15.OUT


TIME:  10:30     DATE:   3/30/1996
```

SUMMARY OUTPUT FOR!
100-YEAR RUN
FOR
0.012 ACRE STRIP
(i.e. 500' LONG, 1' WIDE
STRIP, FOR DRAINAGE CALC
PURPOSES)

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******************************************************************************

     TITLE:  HIMCO DUMP SUPERFUND SITE

******************************************************************************


       NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
                COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                    LAYER  1
                                    --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER    6
             THICKNESS                     =      6.00    INCHES
             POROSITY                      =      0.4530 VOL/VOL
             FIELD CAPACITY                =      0.1900 VOL/VOL
             WILTING POINT                 =      0.0850 VOL/VOL
             INITIAL SOIL WATER CONTENT    =      0.3167 VOL/VOL
             EFFECTIVE SAT. HYD. COND.     =  0.720000011000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1398	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.30	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0112	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	55.0000000000	CM/SEC
SLOPE	=	4.00	PERCENT
DRAINAGE LENGTH	=	500.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 37

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999999000E-10	CM/SEC
FML PINHOLE DENSITY	=	4.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	3.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.20	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL

INITIAL SOIL WATER CONTENT = 0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.300000003000E-08 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM A USER-SPECIFIED CURVE NUMBER OF 74.0, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 500. FEET.

SCS RUNOFF CURVE NUMBER	=	74.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	0.012	ACRES
EVAPORATIVE ZONE DEPTH	=	14.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.149	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.054	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.654	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	4.570	INCHES
TOTAL INITIAL WATER	=	4.570	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
FORT WAYNE INDIANA

STATION LATITUDE	=	41.50 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	116
END OF GROWING SEASON (JULIAN DATE)	=	289
EVAPORATIVE ZONE DEPTH	=	14.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR FORT WAYNE INDIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.48	1.99	3.05	4.06	2.81	3.94
3.67	3.94	3.22	3.22	2.83	2.95

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR FORT WAYNE INDIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.20	26.40	36.00	48.50	59.10	68.80
72.50	70.90	64.20	53.20	40.30	29.10

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR FORT WAYNE INDIANA AND STATION LATITUDE = 41.00 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.65	2.06	2.99	4.41	2.90	3.64
	3.52	3.92	3.25	3.07	2.74	3.10
STD. DEVIATIONS	1.24	0.98	1.27	1.55	1.27	1.57
	1.57	1.88	1.52	1.97	1.33	1.43
RUNOFF						
TOTALS	0.969	1.563	1.961	0.701	0.001	0.010
	0.004	0.031	0.005	0.025	0.009	0.413
STD. DEVIATIONS	1.023	1.297	1.400	1.146	0.011	0.040
	0.021	0.091	0.021	0.074	0.041	0.661
EVAPOTRANSPIRATION						
TOTALS	0.398	0.358	0.714	2.961	2.951	3.019
	3.059	2.606	2.596	1.568	0.934	0.546
STD. DEVIATIONS	0.098	0.110	0.494	0.833	1.001	1.250
	1.173	1.174	0.878	0.627	0.242	0.181
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.2975	0.0961	0.9227	2.2932	0.8804	0.6104
	0.5254	0.8971	0.8665	0.9817	1.0346	1.4116
STD. DEVIATIONS	0.3432	0.1196	1.0050	1.2293	0.4721	0.4354
	0.3335	0.9220	0.6995	1.1115	0.8513	1.1150

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0004	0.0001	0.0012	0.0031	0.0011	0.0008
	0.0007	0.0012	0.0012	0.0013	0.0014	0.0018
STD. DEVIATIONS	0.0004	0.0002	0.0013	0.0016	0.0006	0.0006
	0.0004	0.0012	0.0009	0.0014	0.0011	0.0014

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.24 (5.195)	1596.3	100.00
RUNOFF	5.694 (2.8432)	237.68	14.890
EVAPOTRANSPIRATION	21.710 (2.9814)	906.28	56.775
LATERAL DRAINAGE COLLECTED FROM LAYER 3	10.81710 (2.86375)	451.560	28.28871
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00023 (0.00000)	0.010	0.00061
AVERAGE HEAD ON TOP OF LAYER 4	0.001 (0.000)		
CHANGE IN WATER STORAGE	0.005 (1.1801)	0.23	0.014

****

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	4.35	181.591
RUNOFF	4.458	186.1146
DRAINAGE COLLECTED FROM LAYER 3	1.74687	72.92294
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000001	0.00005
AVERAGE HEAD ON TOP OF LAYER 4	0.070	
MAXIMUM HEAD ON TOP OF LAYER 4	0.142	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	8.02	334.9937

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4029
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0467

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	2.5543	0.4257
2	2.4051	0.1336
3	0.0031	0.0105
4	0.0000	0.0000
5	0.1500	0.7500
SNOW WATER	0.000	

****
****

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                 HELP MODEL VERSION 3.04a  (10 JULY 1995)                 **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP3\himcol.D4
TEMPERATURE DATA FILE:        C:\HELP3\himcol.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\himcol.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\himcol.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\himcol6.D10
OUTPUT DATA FILE:             C:\HELP3\himcol6.OUT

TIME: 11: 5     DATE:   3/30/1996
```

Summary Output For!
30-year Run
0.012 Acre Strip
(i.e. 500' long, 1' wide strip)

```
******************************************************************************

     TITLE:  HIMCO DUMP SUPERFUND SITE

******************************************************************************


      NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
               COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER   6
        THICKNESS                    =      6.00   INCHES
        POROSITY                     =     0.4530 VOL/VOL
        FIELD CAPACITY               =     0.1900 VOL/VOL
        WILTING POINT                =     0.0850 VOL/VOL
        INITIAL SOIL WATER CONTENT   =     0.3168 VOL/VOL
        EFFECTIVE SAT. HYD. COND.    =  0.720000011000E-03 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
               FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0450 VOL/VOL
WILTING POINT	=	0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1401 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.30 INCHES
POROSITY	=	0.8500 VOL/VOL
FIELD CAPACITY	=	0.0100 VOL/VOL
WILTING POINT	=	0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0112 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	55.0000000000 CM/SEC
SLOPE	=	3.85 PERCENT
DRAINAGE LENGTH	=	500.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 37

THICKNESS	=	0.04 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999999000E-10 CM/SEC
FML PINHOLE DENSITY	=	4.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	3.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.20 INCHES
POROSITY	=	0.7500 VOL/VOL
FIELD CAPACITY	=	0.7470 VOL/VOL
WILTING POINT	=	0.4000 VOL/VOL

INITIAL SOIL WATER CONTENT = 0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.300000003000E-08 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM A USER-SPECIFIED CURVE NUMBER OF 74.0, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 500. FEET.

SCS RUNOFF CURVE NUMBER	=	74.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	0.012	ACRES
EVAPORATIVE ZONE DEPTH	=	14.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.152	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.054	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.654	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	4.575	INCHES
TOTAL INITIAL WATER	=	4.575	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
FORT WAYNE INDIANA

STATION LATITUDE	=	41.50	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	116	
END OF GROWING SEASON (JULIAN DATE)	=	289	
EVAPORATIVE ZONE DEPTH	=	14.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR FORT WAYNE INDIANA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.48	1.99	3.05	4.06	2.81	3.94
3.67	3.94	3.22	3.22	2.83	2.95

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR FORT WAYNE INDIANA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.20	26.40	36.00	48.50	59.10	68.80
72.50	70.90	64.20	53.20	40.30	29.10

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR FORT WAYNE INDIANA
AND STATION LATITUDE = 41.50 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
ECIPITATION						
TOTALS	2.36	1.94	2.76	4.66	3.03	3.92
	3.63	3.50	3.06	2.76	2.65	3.25
STD. DEVIATIONS	0.93	1.02	1.16	1.44	1.20	1.64
	1.86	1.78	1.63	1.97	1.41	1.53
RUNOFF						
TOTALS	0.753	1.393	1.488	0.595	0.000	0.011
	0.004	0.011	0.005	0.025	0.004	0.472
STD. DEVIATIONS	0.870	1.156	1.106	1.227	0.000	0.033
	0.012	0.031	0.018	0.094	0.015	0.724
EVAPOTRANSPIRATION						
TOTALS	0.405	0.343	0.770	3.080	3.047	3.284
	3.125	2.414	2.440	1.547	0.882	0.542
STD. DEVIATIONS	0.119	0.100	0.463	0.886	1.074	1.304
	1.357	1.229	0.918	0.567	0.266	0.142
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.3457	0.1241	1.2103	2.1495	0.8915	0.6434
	0.6307	0.8437	0.7854	0.8897	0.9398	1.4570
STD. DEVIATIONS	0.5199	0.1918	1.1533	1.0622	0.3510	0.3682
	0.4426	0.7661	0.5411	1.0912	0.8394	1.1071

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0005	0.0002	0.0016	0.0030	0.0012	0.0009
	0.0008	0.0011	0.0011	0.0012	0.0013	0.0020
STD. DEVIATIONS	0.0007	0.0003	0.0016	0.0015	0.0005	0.0005
	0.0006	0.0010	0.0008	0.0015	0.0012	0.0015

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.54 (5.019)	1567.2	100.00
RUNOFF	4.760 (2.6986)	198.69	12.678
EVAPOTRANSPIRATION	21.877 (3.4963)	913.26	58.275
LATERAL DRAINAGE COLLECTED FROM LAYER 3	10.91085 (2.84686)	455.474	29.06357
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00023 (0.00000)	0.010	0.00062
AVERAGE HEAD ON TOP OF LAYER 4	0.001 (0.000)		
CHANGE IN WATER STORAGE	-0.012 (0.9967)	-0.49	-0.031

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.79	158.214
RUNOFF	4.312	180.0229
DRAINAGE COLLECTED FROM LAYER 3	1.74993	73.05067
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000001	0.00005
AVERAGE HEAD ON TOP OF LAYER 4	0.073	
MAXIMUM HEAD ON TOP OF LAYER 4	0.144	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	6.3 FEET	
SNOW WATER	5.49	229.2501

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3825
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0467

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	1.0856	0.1809
2	2.9807	0.1656
3	0.0055	0.0185
4	0.0000	0.0000
5	0.1500	0.7500
SNOW WATER	0.000	

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site		SHEET NO. 1 OF 2
ITEM Hydr. Conductivity Calcs.		BY RDT DATE 3/96
		CHKD. BY DATE

Hydraulic Conductivity of Sands Determined by Hazen's Equation

$$K = CD_{10}^2$$ where:

k = Hydraulic Conductivity (cm/sec)
C = Constant (Varies from 1 to 1.5)
D_{10} = Effective Grain Size (mm)

Assume $C = 1.0$

$k = D_{10}^2$

Typ Calc: $D_{10} = 0.3\,mm$

$k = (0.3)^2 = 9 \times 10^{-2}$ cm/s

Summary Table

USACE Boring NO.	Sample Depth (ft. BGL)	D_{10} (mm)	K (cm/s)
WT112A	15	0.3	9×10^{-2}
WT112B	60	0.16	3×10^{-2}
WT114B	65	0.26	6×10^{-2}
WT115A	15	0.10	1×10^{-2}
B-9	7.5	0.12	
	3	0.1	
	6.8	0.18	3×10^{-2}
	7.5	0.10	1×10^{-2}
B-10	10	0.19	4×10^{-2}
B-11	8	0.09	8×10^{-3}
RI Borings/ Sample NO.			
B-02		0.02	4×10^{-4}
B-04		0.14	2×10^{-2}
B-06		0.17	3×10^{-2}
B-10		0.17	3×10^{-2}
B-12		0.27	8×10^{-2}

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himco Dump Superfund Site	SHEET NO. 2 OF 2	
ITEM Hyd. Cond. Calcs	BY RJT	DATE 3/9
	CHKD. BY	DATE

RI Boring/Sample NO		D_{10} (mm)	K (cm/s)
B-14		0.14	2×10^{-2}
B-16		0.19	4×10^{-2}
B-18		0.18	3×10^{-2}
B-20		0.20	4×10^{-2}
B-20QC		0.15	2×10^{-2}
B-22		0.22	5×10^{-2}
B-24		0.17	3×10^{-2}
B-24QC		0.17	3×10^{-2}
B-26		0.17	$\times 10^{-2}$
B-28		0.02	$\times 10^{-4}$
B-30		0.025	$\times 10^{-4}$
B-32		0.19	$\times 10^{-2}$
B-34		0.006	$\times 10^{-4}$
B-36		0.18	$\times 10^{-2}$
B-38		0.17	$\times 10^{-2}$
B-40		0.002	$\times 10^{-4}$
B-42		N/A	N/A
B-44		N/A	N/A
B-46		0.04	$\times 10^{-4}$
B-48		N/A	N/A
B-50		N/A	N/A
B-52		0.03	$\times 10^{-4}$
B-54		0.017	$\times 10^{-4}$
B-56		0.12	$\times 10^{-2}$
B-56QC		0.04	$\times 10^{-4}$
B-58		0.15	$\times 10^{-2}$

MRO Form 1550, 1 DEC 83

☆ U.S.G.P.O.: 1993-556-577

1. **ROAD DESIGN.**

1.0.1. **Permits.** Permits and approval for constructing the new access roads will be required from the city and county.

1.0.2. **Access Road "A".**

1.0.2.1. **Traffic.** Design of the access roads was based on the following criteria:

Class "E" Road
T = 10%
Design Speed = 30 mph
Average Running Speed = 27 mph

1.0.2.2. **Horizontal Alignment.**

Desirable Maximum Degree of Curvature = 8 degrees
Absolute Maximum Degree of Curvature = 21 degrees

1.0.2.3. **Vertical Alignment.**

Desirable Maximum Grade = 6%
Critical Length = 450 ft.
Absolute Maximum Grade = 10%
Critical Length = 450 ft.
Minimum Stopping Sight Distance = 400 ft.
Vertical Curves
Crest K = 28
Sag K = 35
Minimum Length = 90 ft.

1.0.2.4. **Normal Cross-Section Elements.**

Width of Traffic Lanes = 12 ft.
Traffic Lane Cross Slope = 1/4 in./ft.
Front Slope, 1V on 4H
Back Slope, 1V on 3H

1.1. **PAVEMENT DESIGN.**

1.1.1. **ACCESS ROAD "A".** The turnout from John Weaver Parkway will be paved with bituminous pavement. The remainder of the road will be paved with aggregate surface course.

1.1.1.1. **Bituminous Pavement.**

1.1.1.1.1. **Traffic.** Traffic consists of the following vehicles:

85% Passenger cars, panel trucks, and pickup trucks

14% Two-axle trucks

1% Three-, four-, and five- axle trucks

1.1.1.1.2. Strength Method. (Non-Frost Design)

Class = F
Category = III
Design Index = 2
CBR (Compacted Subgrade) = 20
Total Design Thickness = 3.8 inches
Compacted Subgrade Thickness = 6 inches

1.1.1.1.3. Reduced Subgrade Strength Method. (Frost Design)

Design Index = 2
Soil Group = F3
Soil Support Index = 3.5
Total Design Thickness = 15.5 inches

1.1.1.1.4. Recommended Pavement Section.

2.5-inches Bituminous Pavement
6-inches Aggregate Base Course
6-inches Subbase Course
6-inches Compacted Subgrade (95% maximum density)

1.1.1.2. Aggregate Surfacing.

1.1.1.2.1. Traffic. Traffic consists of the following vehicles:

85% Passenger cars, panel trucks, and pickup trucks

14% Two-axle trucks

1% Three-, four-, and five- axle trucks

1.1.1.2.2. Strength Method. (Non-Frost Design)

Class = G
Category = I
Design Index = 1
CBR (Compacted Subgrade) = 20

Total Design Thickness = 1.7 inches
Compacted Subgrade Thickness = 6 inches

1.1.1.2.3. Reduced Subgrade Strength Method. (Frost Design)

Design Index = 1
Soil Group = F3
Soil Support Index = 3.5
Total Design Thickness = 9 inches

1.1.1.2.4. Recommended Pavement Section.

8-inches Aggregate Surfacing
6-inches Compacted Subgrade
(95% maximum density)

1.1.2. ACCESS ROADS "B", "C", AND "D". The Acess Road "B" turnout from County Road 10 will be paved with bituminous pavement. The remainder of the roads will be paved with aggregate surface course.

1.1.2.1. Bituminous Pavement.

1.1.2.1.1. Traffic. Traffic consists of the following vehicles:

99% Passenger cars, panel trucks, and pickup trucks

1% Two-axle trucks

1.1.2.1.2. Strength Method. (Non-Frost Design)

Class = F
Category = I
Design Index = 1
CBR (Compacted Subgrade) = 20
Total Design Thickness = 3.2 inches
Compacted Subgrade Thickness = 6 inches

1.1.2.1.3. Reduced Subgrade Strength Method. (Frost Design)

Design Index = 1
Soil Group = F3
Soil Support Index = 3.5
Total Design Thickness = 13.5 inches

1.1.2.1.4. Recommended Pavement Section.

2.5-inches Bituminous Pavement
6-inches Aggregate Base Course
5-inches Subbase Course
6-inches Compacted Subgrade
(95% maximum density)

1.1.2.2. Aggregate Surfacing.

1.1.2.2.1. Traffic. Traffic consists of the following vehicles:

99% Passenger cars, panel trucks, and pickup trucks

1% Two-axle trucks

1.1.2.2.2. Strength Method. (Non-Frost Design)

Class = G
Category = III
Design Index = 1
CBR (Compacted Subgrade) = 20
Total Design Thickness = 1.7 inches
Compacted Subgrade Thickness = 6 inches

1.1.2.2.3. Reduced Subgrade Strength Method. (Frost Design)

Design Index = 1
Soil Group = F3
Soil Support Index = 3.5
Total Design Thickness = 9 inches

1.1.2.2.4. Recommended Pavement Section. Because of the low traffic volume, the design thickness determined using the reduced subgrade strength method will be decreased.

6-inches Aggregate Surfacing
6-inches Compacted Subgrade
(95% maximum density)

APPENDIX B

REMEDIAL ACTION

HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX B
SOIL GAS SURVEY

Quadrel Report No. QS1287

EMFLUX® Passive, Non-Invasive Soil-Gas Survey:

HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA

Prepared for

U.S. Army Corps of Engineers
215 North 17th Street
Omaha, NE 68102-4978

by

Quadrel Services, Inc.
1896 Urbana Pike
Suite 20
Clarksburg, MD 20871

August 31, 1995

B-2

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APPENDICES

FIGURES

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EMFLUX® PASSIVE, NON-INVASIVE
SOIL-GAS SURVEY
of

HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA

The following EMFLUX® Methane Survey Report on the HIMCO Dump Superfund Site (HIMCO Dump) has been prepared for the U.S. Army Corps of Engineers (USACE) by Quadrel Services, Inc. (Quadrel) in accordance with the terms of USACE Purchase Order No. DACW45-95-P-1084/Purchase Request No. EDGG*A-5192-0013 dated July 27, 1995. Quadrel's principal contact for this project has been Mr. Rick Grabowski.

1.0 OBJECTIVES

At the request of USACE, Quadrel conducted an EMFLUX® Survey of a 45-acre section of the HIMCO Dump, a Superfund Site in Elkhart County, Indiana. The purpose of this EMFLUX® Methane Survey was to verify the presence of methane and, assuming verification, to estimate the annual Methane generation rate.

2.0 BACKGROUND

Based on publicly available information[1], the HIMCO Dump is a closed and covered landfill that operated between 1960 and September 1976. The area was initially marsh and grassland; no liner, leachate, or gas-recovery system was constructed for the landfill. It has been reported that essentially two-thirds of the waste in the landfill is calcium sulfate from Miles Laboratories; also present are demolition/construction debris, industrial and hospital wastes, and general household wastes. In 1977 the landfill was closed and covered, using six inches of Calcium Sulfate and one foot of sand.

The Dump is currently surrounded by small wooded areas and interrupted wetlands. The central and eastern portions of the Survey area are characterized by light to heavily wooded terrain and scrub brush, while the western portion is primarily an open field of tall grass.

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[1]U.S. EPA, Region V, *Health and Safety Plan, HIMCO Dump Remedial Investigation/Feasibility Study, Elkhart, Indiana*, Volume 4, July 1990, p. 3-1 through 3-3.

3.4 Field Work

Sample point locations were determined and the Survey area staked on August 7 and 8, 1995. EMFLUX® Methane collection tubes were deployed on August 8 and capped at 0800 hours on August 9; all devices were retrieved on August 10, 1995.

Weather conditions for the most part were clear, but there was a brief period of rain during the afternoon hours of Wednesday, August 9. However, meteorological phenomena are not usually significant factors in EMFLUX® Surveys.

Deployment and retrieval of EMFLUX® devices were accomplished in conformity with Quadrel's established Field Procedures (**Appendix A**).

3.5 Quality Assurance/Quality Control

Field work and reporting were done in accordance with Quadrel's Quality Assurance Program Plan.

4.0 FINDINGS

The following section outlines results of the EMFLUX® investigation of the HIMCO Dump.

4.1 Computations

The Methane percentages obtained in the field were averaged over time at each point, and the results were converted to emission flux rates (ng cm^{-2} s^{-1}) and then to annualized generation rates (in cubic feet per year, ft^3 yr^{-1}) using the following equation.

$$F = P^{4/3} D_a ((C_z N 100)/Z)$$

where:

- F = Average emission flux rate (ng cm^{-2} s^{-1}),
- P = Porosity,
- D_a = Diffusivity coefficient (cm^2 s^{-1}),
- C_z = Methane concentration (percent),
- N = Dimensional conversion factor (for Methane 7,160 ng cm^{-3}),
- 100 = Percent conversion factor, and
- Z = depth (cm)

Based on published porosities[2], the average porosity for the mixed sand used in the cap of the HIMCO Dump was assumed to be 0.35; the diffusivity coefficient D_a of Methane in free air is 0.165 cm^2 s^{-1}.

[2]Todd, D.K., *Ground Water Hydrology* (New York: 1959).

5.0 DISCUSSION

5.1 Summary

Quadrel obtained varying but substantial Methane readings at 37 probe locations, most of which were within the boundaries of the landfill area; values ranged from 0.1 ng cm^{-2} s^{-1} to 496.7 ng cm^{-2} s^{-1}. By contrast, the company found no traces of Methane at 40 locations, most of which were near the perimeter or outside of the landfill.

Based on the data collected during the 24-hour Survey period, Quadrel estimates that the HIMCO Dump Superfund Site is producing Methane at an annualized rate of 287 million cubic feet per year (ft^3 yr^{-1}).

5.2 Commentary

5.2.1 The highest mean Methane concentration, 64.9%, occurred at probe 45; the next three highest values, 57.8%, 55.0%, and 51.6%, were found at probes 8, 24, and 9, respectively.

5.2.2 The majority of Methane detected was found in two large groupings of detections located in the central and western portions of the landfill (**Figure 3**). These groupings are separated by nondetections at probes 11, 15, 22, and 31 and by low detections at probes 16, 32, and 37. It is of possible significance to note that the areas of high detection (above 200 ng cm^{-2} s^{-1}) appear to track to the main landfill access road shown in **Figure 1**.

5.2.3 Isolated, but possibly significant detections were made at probes 61, 62, and 77 near the southeastern perimeter of the HIMCO Site (**Figures 2 and 3**).

5.2.4 Olfactory detections of Hydrogen Sulfide were made by all three Quadrel field teams during each scheduled sampling period. It was observed that those probe locations which produced a strong Hydrogen Sulfide odor also yielded high Methane detections.

5.2.5 Methane detections on the HIMCO Dump were found at very consistent levels, with the average range factor for all points being only 5.2%. While large and predictable fluctuations in Methane emissions are generally associated with areas of subsurface soil-gas migration, consistent Methane emission levels such as those found on this site typically indicate areas currently producing Methane.

MTCrpt\QS1287

Table 1 (cont.)
Methane Concentrations (%)
HIMCO Dump Superfund Site, Elkhart, IN

Date	8/9/95			8/10/95				Range		
Time	1200 hours	1600 hours	2000 hours	0000 hours	0400 hours	0800 hours	Mean	Low	High	Factor
Sample										
21	31.7%	31.8%	31.6%	31.5%	32.0%	31.8%	31.7%	31.5%	32.0%	1.0
22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
23	51.8%	0.8%	0.3%	0.2%	0.3%	10.7%	10.7%	0.2%	51.8%	259.0
24	55.3%	55.0%	55.3%	54.5%	55.2%	54.5%	55.0%	54.5%	55.3%	1.0
25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
26	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
27	0.0% *	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	1.4%	0.3%	0.2
28	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
29	16.9% *	18.7%	19.2%	19.3%	19.7%	19.7%	19.3%	18.7%	19.7%	1.1
30	0.0% *	29.9%	31.3%	30.8%	31.6%	31.8%	31.1%	29.9%	31.8%	1.1
31	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
32	0.0% *	1.4%	1.2%	1.1%	0.8%	0.6%	1.0%	0.6%	1.4%	2.3
33	0.0% *	3.1%	2.2%	1.3%	1.0%	0.7%	1.7%	0.7%	3.1%	4.4
34	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
35	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
36	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
37	0.0% *	1.3%	1.2%	1.2%	1.2%	1.3%	1.2%	1.2%	1.3%	1.1
38	0.0% *	30.4%	30.2%	30.5%	30.4%	30.6%	30.4%	30.2%	30.6%	1.0
39	0.0% *	32.3%	48.0%	48.9%	48.3%	48.8%	45.3%	32.3%	48.9%	1.5
40	0.0% *	0.5%	0.8%	1.3%	1.9%	0.9%	1.1%	0.5%	1.9%	3.8

Note: * These measurements have not been used in the calculation of Mean values because of equipment difficulties in the field.
NI No information is available because water in the analyzer tube terminated these samplings.

Table 1 (cont.)
Methane Concentrations (%)
HIMCO Dump Superfund Site, Elkhart, IN

Date	8/9/95			8/10/95				Range		
Time	1200 hours	1600 hours	2000 hours	0000 hours	0400 hours	0800 hours	Mean	Low	High	Factor
Sample										
61	4.2%	4.2%	4.3%	4.3%	4.4%	4.5%	4.3%	4.2%	4.4%	1.0
62	45.8%	52.0%	44.3%	53.7%	52.8%	53.0%	50.3%	44.3%	53.7%	1.2
63	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
64	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
65	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
66	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
67	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	--
68	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
69	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
70	0.0%	*NI*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
71	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
72	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
73	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
74	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
76	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
77	9.9%	9.6%	9.1%	9.2%	9.0%	8.1%	9.2%	8.1%	9.9%	1.2

Note: * These measurements have not been used in the calculation of Mean values because of equipment difficulties in the field.
NI No information is available because water in the analyzer tube terminated these samplings.

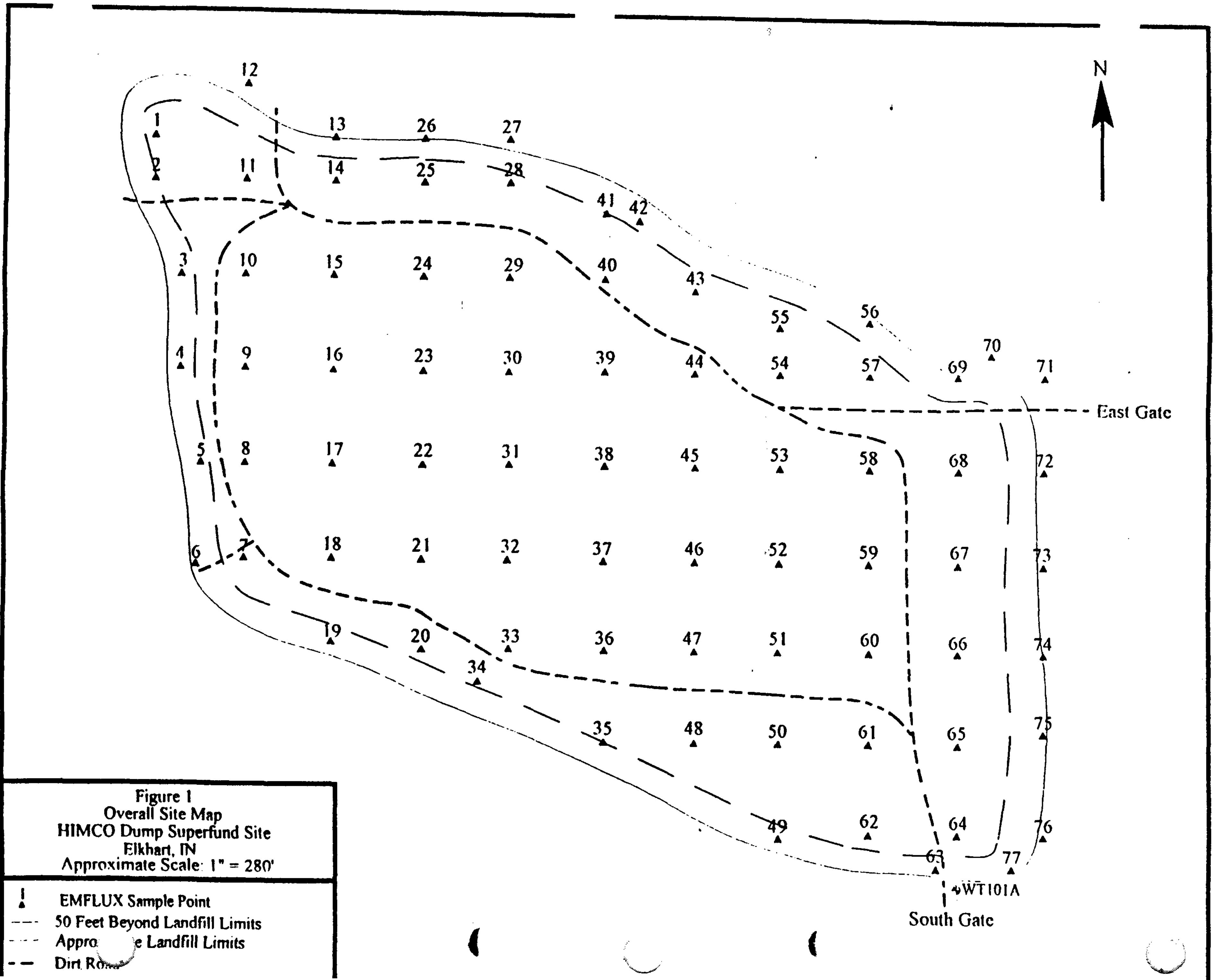


Figure 1
Overall Site Map
HIMCO Dump Superfund Site
Elkhart, IN
Approximate Scale: 1" = 280'

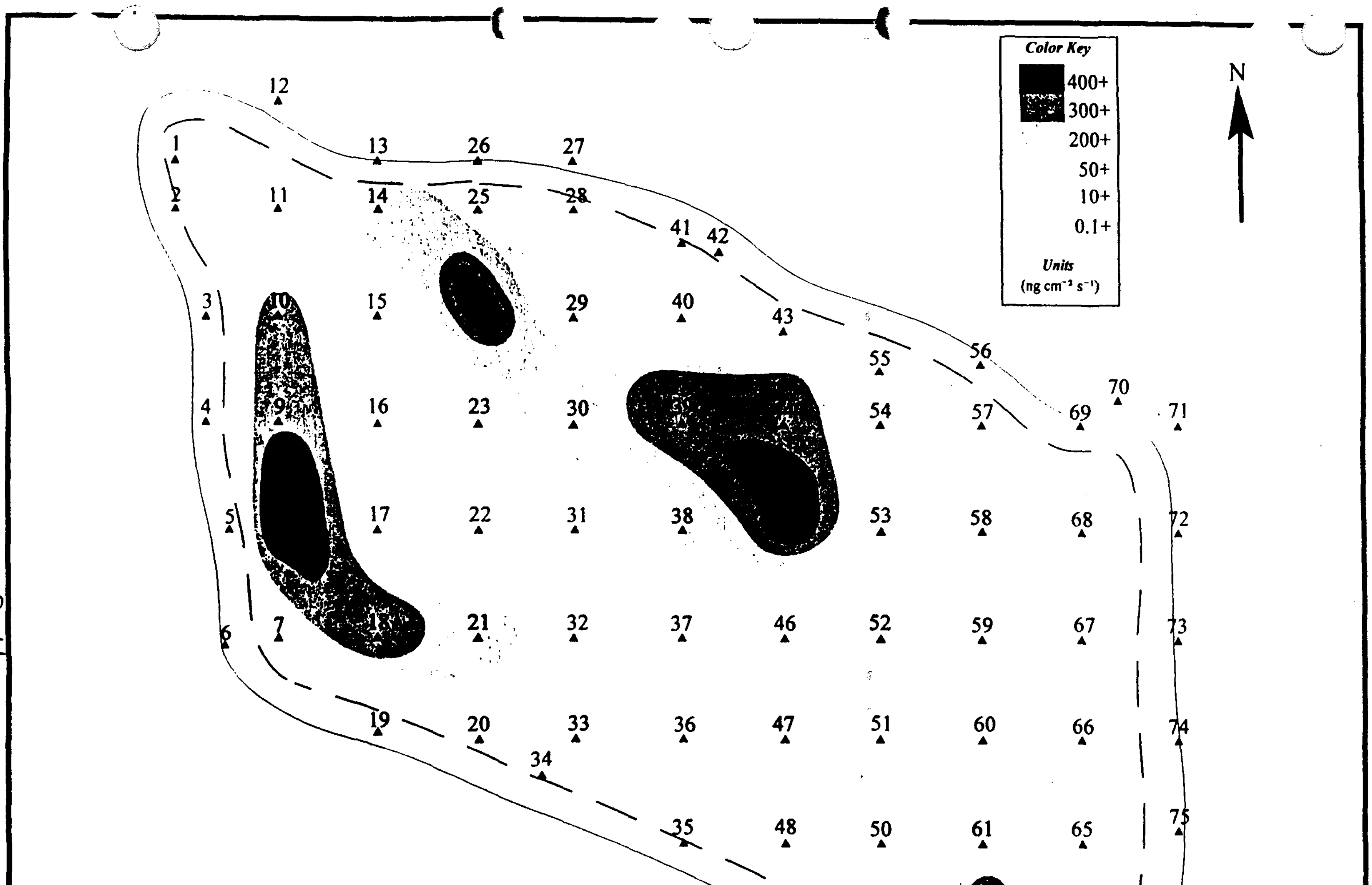


Figure 3
Methane Isopleths
HIMCO Dump Superfund Site
Elkhart, IN
Approximate Scale: 1" = 280'

EMFLUX Sample Point
50 Feet Beyond Landfill Limits
Approximate Landfill Limits

Appendix B
Field Deployment Report

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO_2	Remarks
MTC/JW	8/9/95	19	1305	16.1	24.2	
		20	1300	0.0	1.9	
		21	1258	31.7	36.5	
		22	1255	0.0	0.0	
		23	1252	51.8	30.6	
		24	1249	55.3	46.0	
		25	1245	0.0	0.1	
		26	1247	0.0	0.3	

QUADREL RVICES, INC.
METHANE DATA SHEET

CLIENT: USACE SITE: Himco Landfill

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO_2	Remarks
DS/WH	8-9-95	49	1252	0.0	0.0	
		50	12:49	0.0	0.0	
		51	12:56	0.0	0.0	
		52	12:58	0.0	0.0	
B-14						

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO_2	Remarks
		71	12:40	0.0	0.7	
		72	12:46	0.0	0.3	
		73	12:49	0.0	0.9	
		74	12:51	0.0	3.7	
		75	12:54	0.0	0.4	Flow disrupted at 5" [illegible]
		76	12:56	0.0	3.0	
		77	12:58	9.9	22.4	

B-15

Te.. Initials	Date	Sample Number	Time (24 hours)	Perce.. Methane	Percent CO_2	Remarks
MK/JW	8/9/95	23	1707	0.8	0.6	
↓	↓	24	1704	55.0	47.1	
↓	↓	25	~~0.0~~ 1659	0.0	0.7	
↓	↓	26	1701	0.0	0.4	
		[illegible]				

B-16

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO_2	Remarks
DS/WH	8-9-95	49	1655	0.0	12.7	
		50	1657	0.0	14.1	
		51	1702	0.0	2.7	
		52	1704	11.2	26.7	

B-17

Tea Initials	Date	Sample Number	Time (24 hours)	Percen Methane	Percent CO_2	Remarks
HO/Bm	8/7	75	1701	0.0	0.0	
		76	1704	0.0	3.4	
		77	1706	9.6	21.5	

B-18

Te Initials	Date	Sample Number	Time (24 hours)	Perce Methane	ercent CO_2	Remarks
MTC / JW	8-9-95	23	2107	0.3	0.2	Flow problems ?
		24	2104	55.3	47.5	
		25	2100	0.0	0.6	
		26	2102	0.0	0.4	

B-19

Te... Initials	Date	Sample Number	Time (24 hours)	Percen... Methane	Percent CO_2	Remarks
DS/WH	8-9-95	49	2103	0.0	14.1	
		50	2100	0.0	12.7	
		51	2108	0.0	2.9	
		52	2112	11.7	26.6	

B-20

Te Initials	Date	Sample Number	Time (24 hours)	Perce Methane	Percent CO_2	Remarks
HO/BM	8-9-95	75	2057	0.0	0.1	light Vacuum Pressure
↓	↓	76	2059	0.0	4.1	
		77	2103	9.1	22.5	
B-21						

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO_2	Remarks
MC / JU	8-10-95	23	0042	0.2	0.3	NO Flow Problem
↓	↓	24	0040	54.5	45.6	
		25	0035	0.0	1.0	
		26	0037	0.0	0.3	

B-22

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO_2	Remarks
DS/WH	8-10-95	49	0055	0.0	7.4	
		50	0054	0.0	4.5	
		51	0058	0.0	1.5	
		52	0101	13.2	27.7	

Te[illegible] Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO_2	Remarks
HO/BM	8/10/95	75	0050	0.0	4.3	
↓	↓	76	0053	0.0	0.2	
		77	0058	9.2	22.6	
B-24						

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO_2	Remarks
MTC / JW	8-10-95	23	0446	0.3	0.3	Flow Problem
		24	0444	55.2	462	
		25	0440	0.0	0.2	
		26	0441	0.0	0.4	
B-25						

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO_2	Remarks
DS/WH	8/10/95	49 ~~50~~	0453	0.0	1.7	
		50 ~~51~~	0450	0.0	2.0	
		51 ~~52~~	0452	0.0	1.1	
		52	0456	14.0	29.0	
B-26						

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO_2	Remarks
40/BM	8/10/75	75	0453	0.0	0.4	
		76	0456	0.0	4.2	
		77	0458	9.0	22.6	
B-27						

Tea Initia..	Date	Sample Number	Time (24 hours)	Percen Methane	Percent CO_2	Remarks
MTL/JW	8-10-95	23	0844	10.7	7.4	No Flow Problem
		24	0842	54.5	45.4	
		35	0838	0.0	0.5	
		26	08 39	0.0	0.2	

Tea Initials	Date	Sample Number	Time (24 hours)	Percen. Methane	rcent CO_2	Remarks
DS/WH	8.10.95	49	0851	0.0	2.6	
↓	↓	50	0849	0.0	2.7	
		51	0854	0.0	1.7	
		52	0856	14.9	28.4	
B-29						

APPENDIX C

REMEDIAL ACTION

HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX C
GEOTECHNICAL LABORATORY DATA

HAND AUGER SAMPLE LOCATIONS

C-2

DEPARTMENT OF THE ARMY
Missouri River Division, Corps of Engineers
Division Laboratory
Omaha, Nebraska

TABLE 1 - SUMMARY OF CLASSIFICATION TESTS

Project: HIMCO Superfund Site MRD Lab No. 3584

Holes WT 112A through WT 118B

Note: By visual examination and classification, samples not tested were compared and grouped with typical test samples described below:

(a) Sand SP. Brown with White and Black. Fine to coarse sand. Nonplastic. Similar to Hole WT 112A, Sample 1 (1.8% Fines, 92.4% Sand, 5.8% Gravel; Cu-2.44, Cc-1.02).

(b) Sand SP. Grayish Brown with Black. Fine to medium sand. Nonplastic. Similar to Hole WT 112B, Sample 1 (1.5% Fines, 98.5% Sand; 'u-1.92, Cc-1).

(c) Gravelly Sand SP. Gray, Black and White. Fine sand to fine gravel. Nonplastic. Similar to Hole WT 114B, Sample 1 (1.5% Fines, 81.3% Sand, 17.2% Gravel; Cu-9.24, Cc-0.92).

(d) Sand SP. Yellowish Brown. Fine sand. Nonplastic. Similar to Hole WT 115A, Sample 1 (2.8% Fines, 96% Sand, 1.2% Gravel; Cu-2.7, Cc-1.32).

(e) Sand SP. Dark Gray with White. Fine to medium sand. Nonplastic. Similar to Hole WT 116A, Sample 1 (1.3% Fines, 98.2% Sand, 0.5% Gravel; Cu-2.46, Cc-0.86).

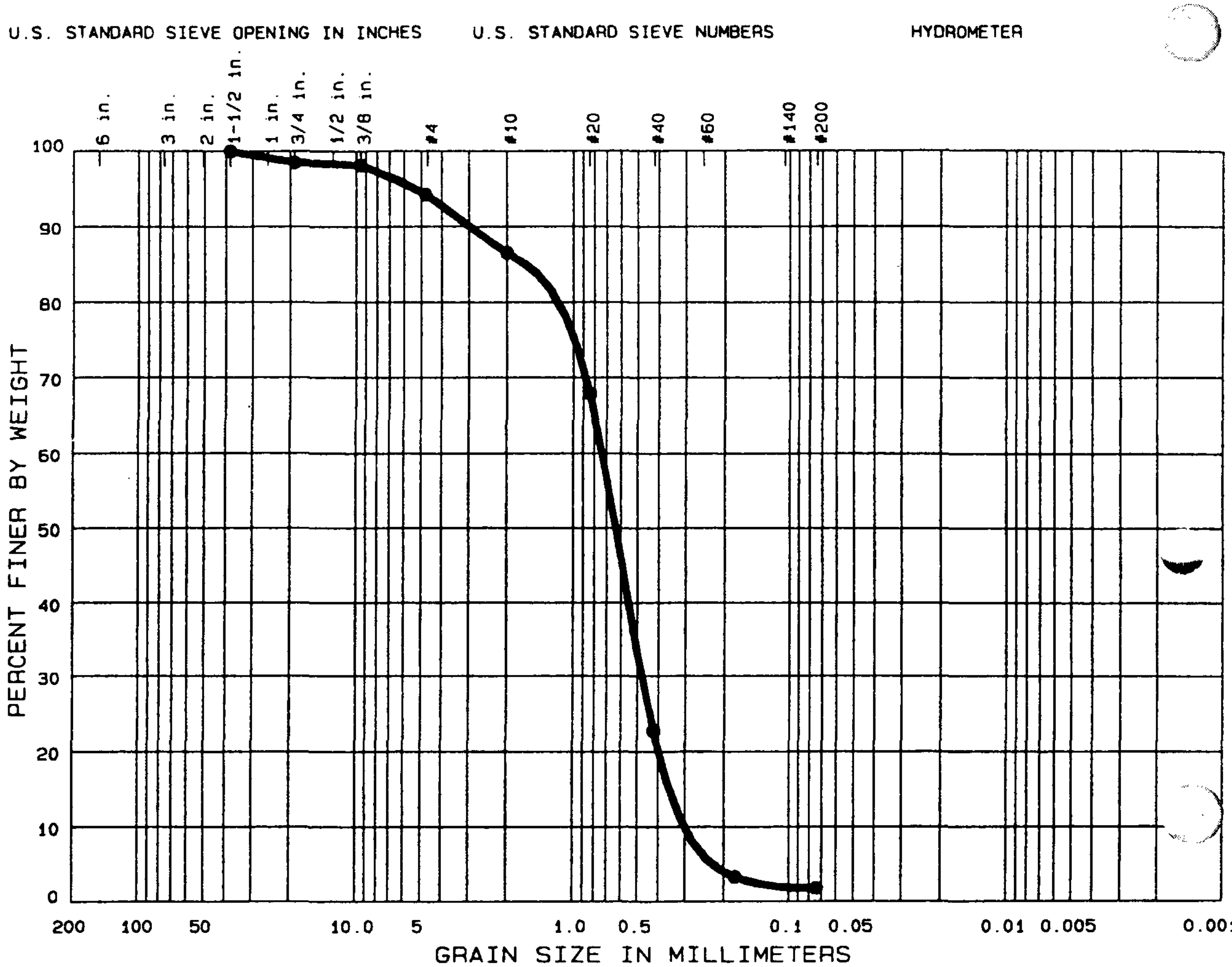
SOIL CLASSIFICATION RECORD SHEET

PROJECT: HIMCO Dump Superfund Site | BORING: WT 112A through WT 118B | MRI LAB NO. 35

STATION: | RANGE: | SURF.ELEV.: | DEPTH TO WATER TABLE: | DATE: 10 27 85

SAMP NO.	DEPTH TO BOTTOM OF SAMP	MOISTURE (%)	PLASTICITY (ATT. LIMITS) LL	PI	GRADING (CUMULATIVE PERCENTS FINER) HYD. ANALYSIS FINES .005	.02mm	U.S. STANDARD SIEVE SIZE SANDS 200	80	40	20	10	4	GRAVEL 3/8	3/4	1-1/2	3 IN	GRADATION CURVE ANALYSIS D60 (mm)	D30 (mm)	D10 (mm)	Cu	Cc	Dried in 110 Oven?	CLASSIFICATION TECH MEMO 3-357, MAY 67	REMARKS
Hole	WT 112A																							
	15.0						2	3	23	68	87	94	98	99	100		0.73	0.47	0.30	2.44	1.02		Sand SP	Note (a)
Hole	WT 112B																							
1	60.0						2	11	90	99	100	100					0.30	0.22	0.16	1.92	1.00		Sand SP	Note (b)
Hole	WT 113B																							
1	65.0																						Sand SP	Note (b)
Hole	WT 114A																							
1	20.0																						Sand SP	Note (a)
Hole	WT 114B																							
1	65.0						2	4	18	32	54	83	97	100			2.40	0.76	0.26	9.24	0.92		Gravelly Sand SP	Note (c)
Hole	WT 115A																							
1	15.0						3	21	93	97	98	99	100				0.28	0.20	0.10	2.70	1.32		Sand SP	Note (d)
H	116A																							
1	15.0						1	3	49	94	99	100	100				0.50	0.30	0.20	2.46	0.86		Sand SP	Note (e)
Hole	WT 116B																							
1	60.0																						Sand SP	Note (b)
Hole	WT 117A																							
1	15.0																						Sand SP	Note (d)
Hole	WT 117B																							
1	65.0																						Gravelly Sand SP	Note (c)
Hole	WT 118B																							
1	60.0																						Gravelly Sand SP	Note (c)

W.O. No. HSS
Req. No. ENE 5712
Contract No.



% COBBLES		% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	5.8	92.4	1.8

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	WT 112A						1.02	2.4

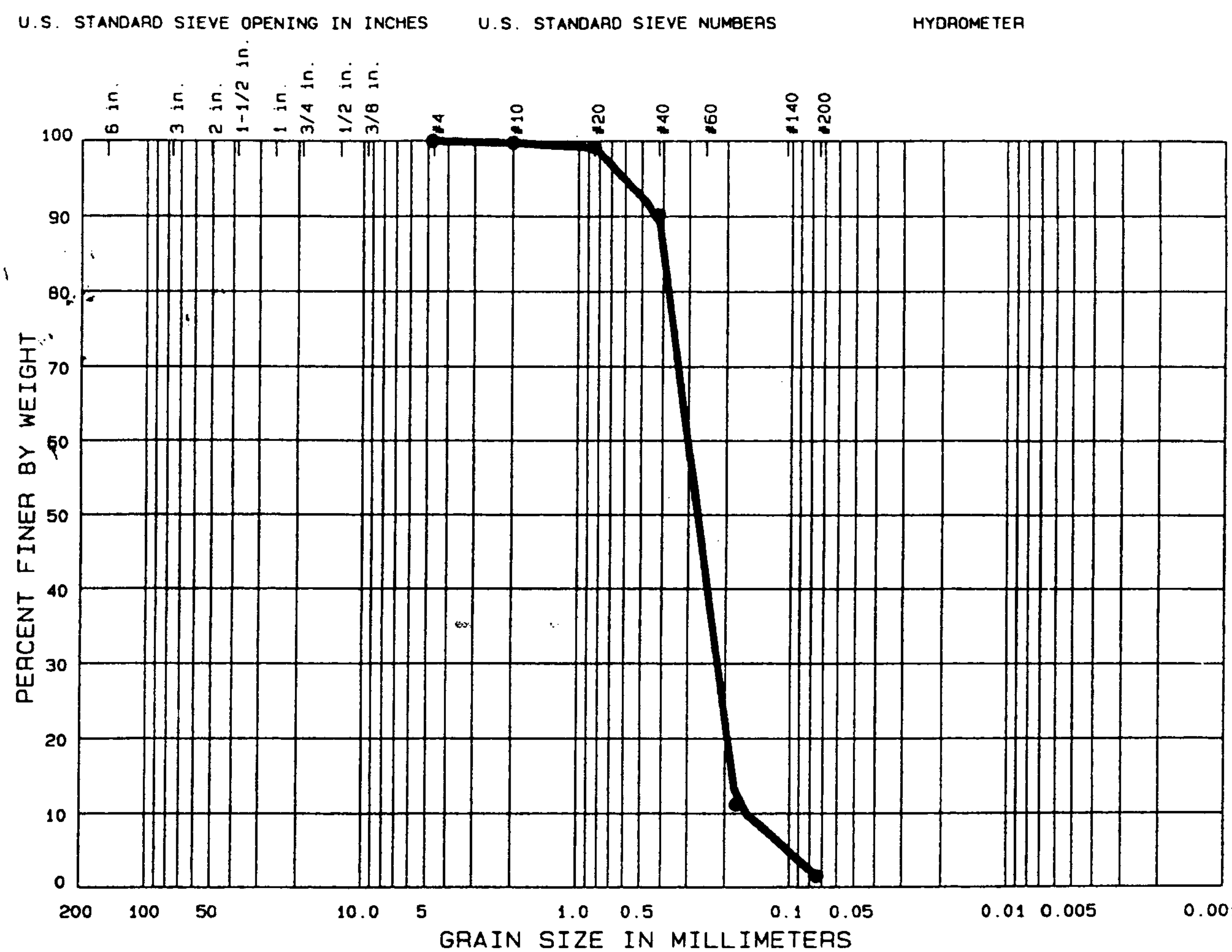
CLASSIFICATION

● SAND, SP

Remarks:	Project HIMCO Superfund Site
	Lab No. 3584
	Area
	Boring No. WT 112A Date 10/27/95

GRADATION CURVES

ORPS OF ENGINEERS, MISSOURI RIVER DIVISION LAB
20 SOUTH 18th STREET - OMAHA, NE 68102-2586



% COBBLES		% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	98.5	1.5

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	WT 112B	58.5'-60'					1.00	1.9

CLASSIFICATION

● SAND, SP

Remarks:

Project HIMCO Superfund Site

Lab No. 3584

Area

Boring No. WT 112B

Date 10/27/95

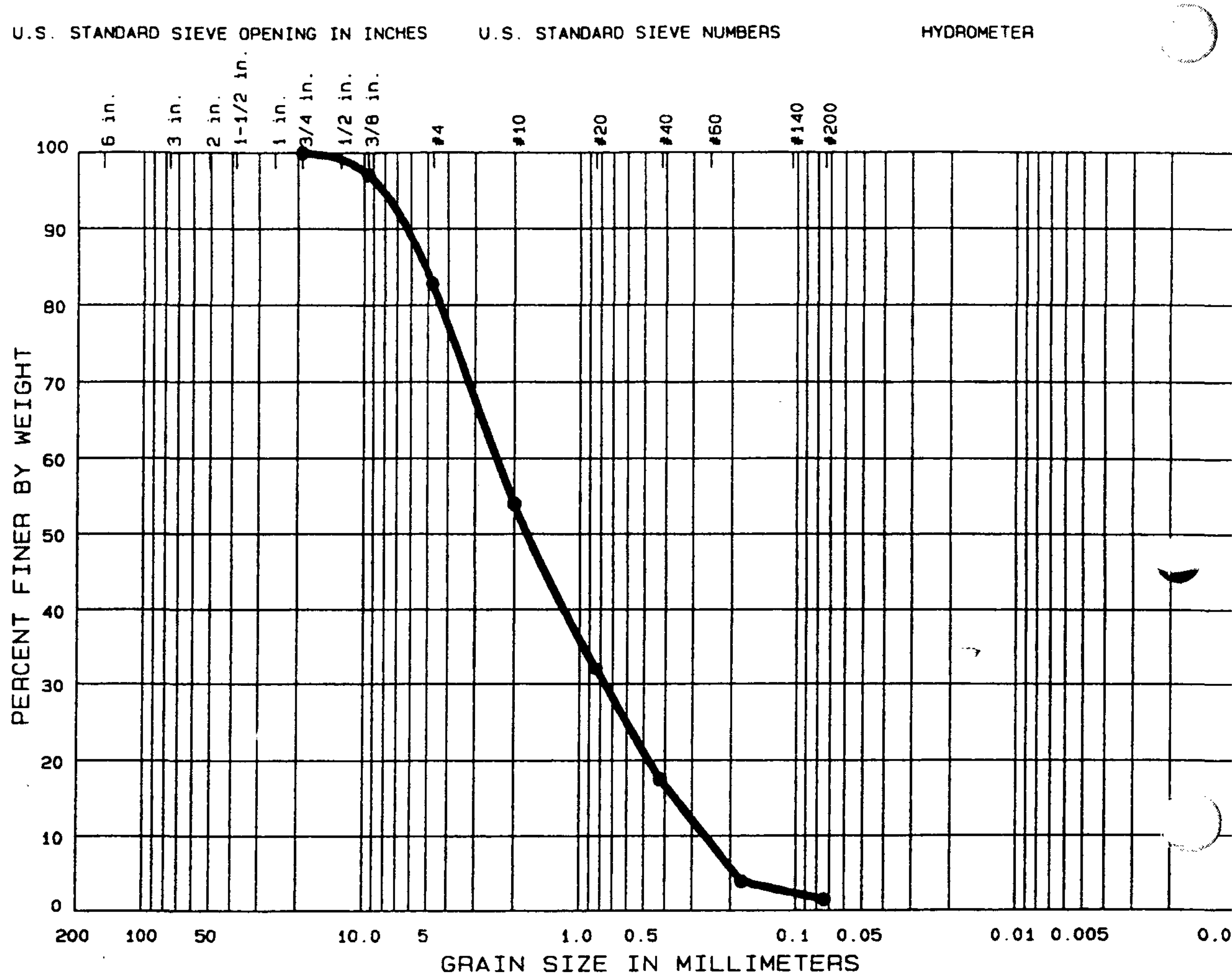
C-6

GRADATION CURVES

W.O. No. HSS
Req. No. ENE 5712
Contract No.

CORPS OF ENGINEERS, MISSOURI RIVER DIVISION LAB
420 SOUTH 18th STREET - OMAHA, NE 68102-2586

W.O. No. HSS
Req. No. ENE 5712
Contract No.



% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
● 0.0	17.2	81.3	1.5

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	WT 114B						0.92	9.2

CLASSIFICATION

● GRAVELLY SAND, SP

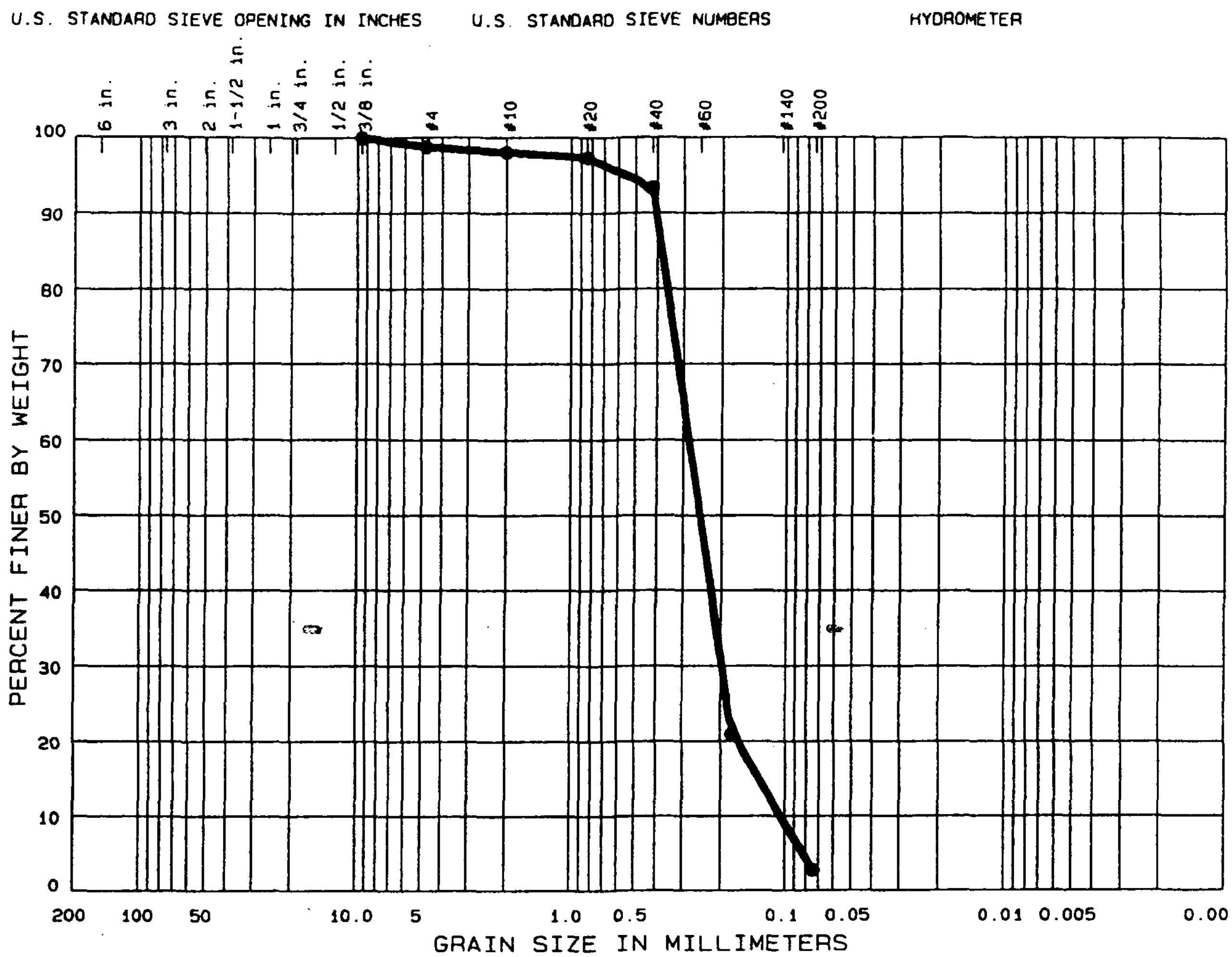
Remarks:	Project HIMCO Superfund Site
	Lab No. 3584
	Area
	Boring No. WT 114B Date 10/27/95

ORPS OF ENGINEERS, MISSOURI RIVER DIVISION LAB
20 SOUTH 18th STREET - OMAHA, NE 68102-2586

C-7

GRADATION CURVES

W.O. No. HSS
Req. No. ENE 5712
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	1.2	96.0	2.8

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	WT 115A	13.5'-15'					1.32	2.7

CLASSIFICATION

● SAND, SP

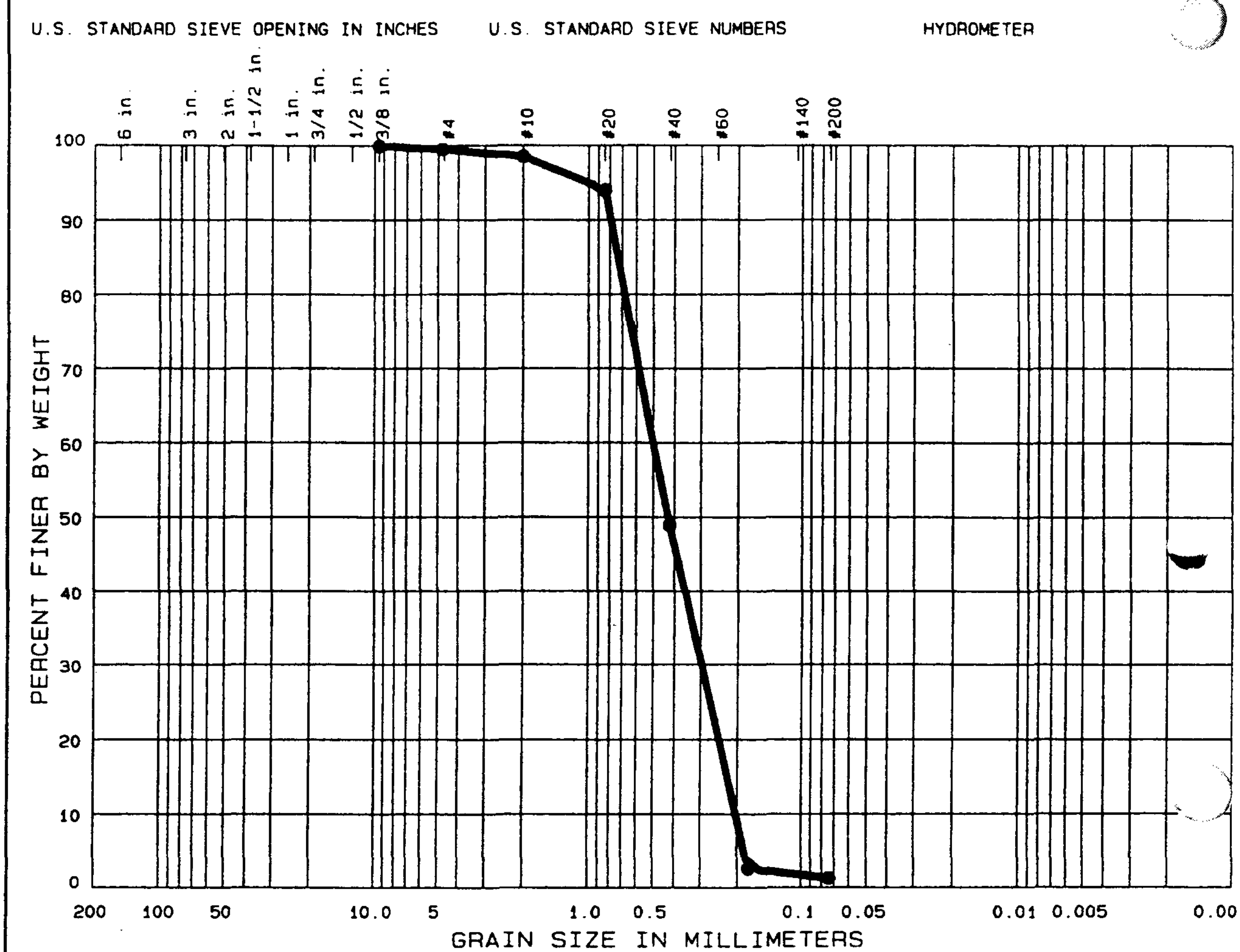
Remarks:	Project HIMCO Superfund Site
	Lab No. 3584
	Area
	Boring No. WT 115A Date 10/27/95

C-8

GRADATION CURVES

CORPS OF ENGINEERS, MISSOURI RIVER DIVISION LAB
420 SOUTH 18th STREET - OMAHA, NE 68102-2586

W.O. No. HSS
Req. No. ENE 5712
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.5	98.2	1.3

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	WT 116A	13'-15'					0.86	2.5

CLASSIFICATION

● SAND, SP

Remarks:	Project HIMCO Superfund Site
	Lab No. 3584
	Area
	Boring No. WT 116A Date 10/27/95

CORPS OF ENGINEERS, MISSOURI RIVER DIVISION LAB
420 SOUTH 18th STREET - OMAHA, NE 68102-2586

C-9

GRADATION CURVES

DEPARTMENT OF THE ARMY
Missouri River Division, Corps of Engineers
Division Laboratory
Omaha, Nebraska

TABLE 1 - SUMMARY OF CLASSIFICATION TESTS

Project: HIMCO Superfund Site MRD Lab No. 3584

Holes A-1 through A-12

Note: By visual examination and classification, samples not tested were compared and grouped with typical test samples described below:

(a) Clayey Sand SC. Dark Brown. Fine to medium sand. Similar to Hole A-1, Sample 1 (25.3% Fines, 74.6% Sand, 0.1% Gravel; LL-34, PI-13).

(b) Silty Clayey Sand SM-SC. Brown. Fine to medium sand. Similar to Hole A-2, Sample 1 (26.9% Fines, 68.7% Sand, 4.4% Gravel; LL-19, PI-6).

(c) Silty Sand SM-SC. Yellowish Brown. Fine to medium sand. Similar to Hole A-3, Sample 1 (19.7% Fines, 77.9% Sand, 2.4% Gravel; LL-16, PI-4).

(d) Silty Sand SP-SM. Brownish Yellow. Fine to coarse sand. Nonplastic. Similar to Hole A-3, Sample 2 (5.2% Fines, 89% Sand, 5.8% Gravel; Cu-3.19, Cc-1.11).

(e) Silty Sand with some gravel SM. Yellowish Brown. Fine to coarse sand. Nonplastic. Similar to Hole A-4, Sample 1 (13.8% Fines, 73.5% Sand, 12.7% Gravel).

(f) Clayey Sand SC. Very Dark Brown. Fine to medium sand. Similar to Hole A-5, Sample 1 (37.1% Fines, 61% Sand, 1.9% Gravel; LL-27, PI-10; Liquid and Plastic Limits run on oven dried sample).

(g) Silty Gravelly Sand SM. Yellowish Brown. Fine sand to fine gravel. Nonplastic. Similar to Hole A-6, Sample 1 (15.2% Fines, 68.1% Sand, 16.7% Gravel).

(h) Silty Sand SM. Grayish Brown. Fine to medium sand. Nonplastic. Similar to Hole A-10, Sample 2 (15% Fines, 79.3% Sand, 5.7% Gravel).

(i) Silty Sand SP-SM. Brown. Fine to medium sand. Nonplastic. Similar to Hole A-10, Sample 3 (5.3% Fines, 94.7% Sand; Cu-2.69, Cc-1.32).

(j) Silty Sand SM. Dark Yellowish Brown. Fine to medium sand. Nonplastic. Similar to Hole A-12, Sample 2 (16.6% Fines, 82.6% Sand, 0.8% Gravel).

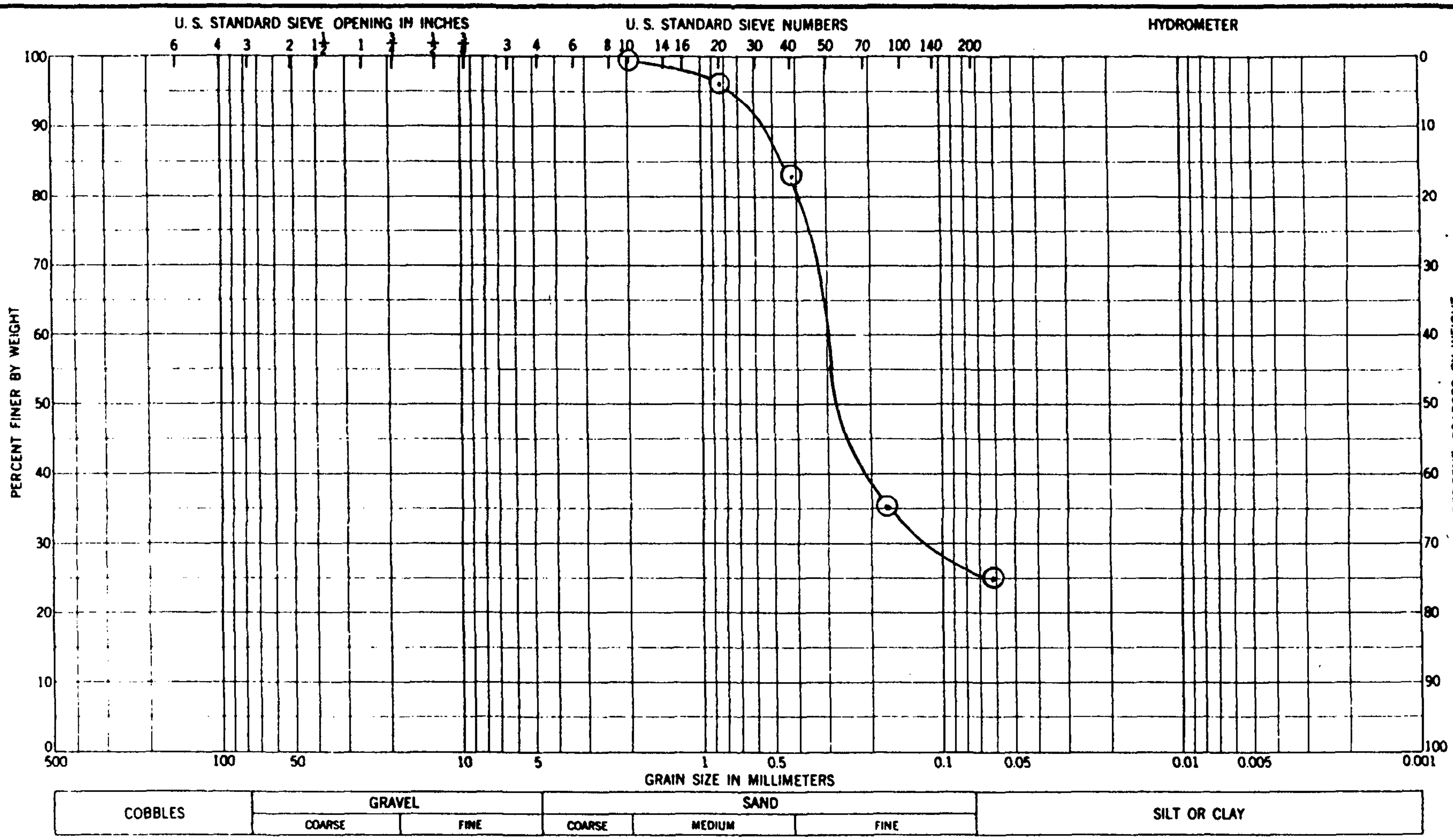
(k) Sand SP. Yellowish Brown. Fine to medium sand. Nonplastic. Similar to Hole A-12, Sample 3 (3% Fines, 97% Sand; Cu-1.77, Cc-0.89).

SOIL CLASSIFICATION RECORD SHEET

HIMCO Superfund Site

	DEPTH TO BOTTOM OF SAMP	MOIST-URE (%)	PLASTICITY (ATT. LIMITS)		GRADING (CUMULATIVE PERCENTS FINER) YSIS	U.S. STANDARD SIEVE SIZE		SANDS				CLASSIFICATION	
			LL	PI	200	80	40	20	10	4	3/8	TECH MEMO 3-357, MAY 67	REMARKS
Hole	A-1												
1	0.4	6.3	34	13	25	35	83	96	99	100	100	Clayey Sand SC	Note (a)
Hole	A-2												
1	0.7	5.7	19	6	27	34	71	86	92	96	98	Silty Clayey Sand SM-SC	Note (b)
Hole	A-3												
1	0.5	5.1	16	4	20	30	76	89	95	98	98	Silty Sand SM-SC	Note (c)
2	3.0	3.8			5	13	62	77	86	94	97	Silty Sand SP-SM	Note (d)
Hole	A-4												
	0.5	2.4			14	21	61	77	83	87	94	Silty Sand w/ gravel SM	Note (e)
Hole	A-5												
1	1.0	31.0	27	10	37	44	76	93	96	98	100	Clayey Sand SC	Note (f) *ovendried prior to att
Hole	A-6												
1	0.5	4.3			15	22	59	73	78	83	88	Silty Gravelly Sand SM	Note (g)
E	A-8												
1	0.4	2.1										Silty Sand SM-SC	Note (c)
Hole	A-9												
1	0.4	2.1										Silty Sand SM-SC	Note (c)
Hole	A-10												
1	0.7	32.4										Clayey Sand SC	Note (f)
2	1.0	8.2			15	20	67	89	92	94	98	Silty Sand SM	Note (h)
	3.0	12.4			5	15	88	99	100	100		Silty Sand SP-SM	Note (i)
Hole	A-11												
1	0.3	6.3										Silty Sand SM-SC	Note (c)
Hole	A-12												
1	0.3	4.7										Silty Sand SM-SC	Note (c)
2	1.0	5.4			17	23	84	97	99	99	99	Silty Sand SM	Note (j)
3	3.0	3.6			3	6	82	99	100	100		Sand SP	Note (k)

Preliminary Report as of [illegible]/20/95



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
D-1	0-0.4'	CLAYEY SAND (SC)	6.3	34	21	13

Project: Himco Dump Superfund Site, Elkhart IN.

Area:

Boring No.: A-1

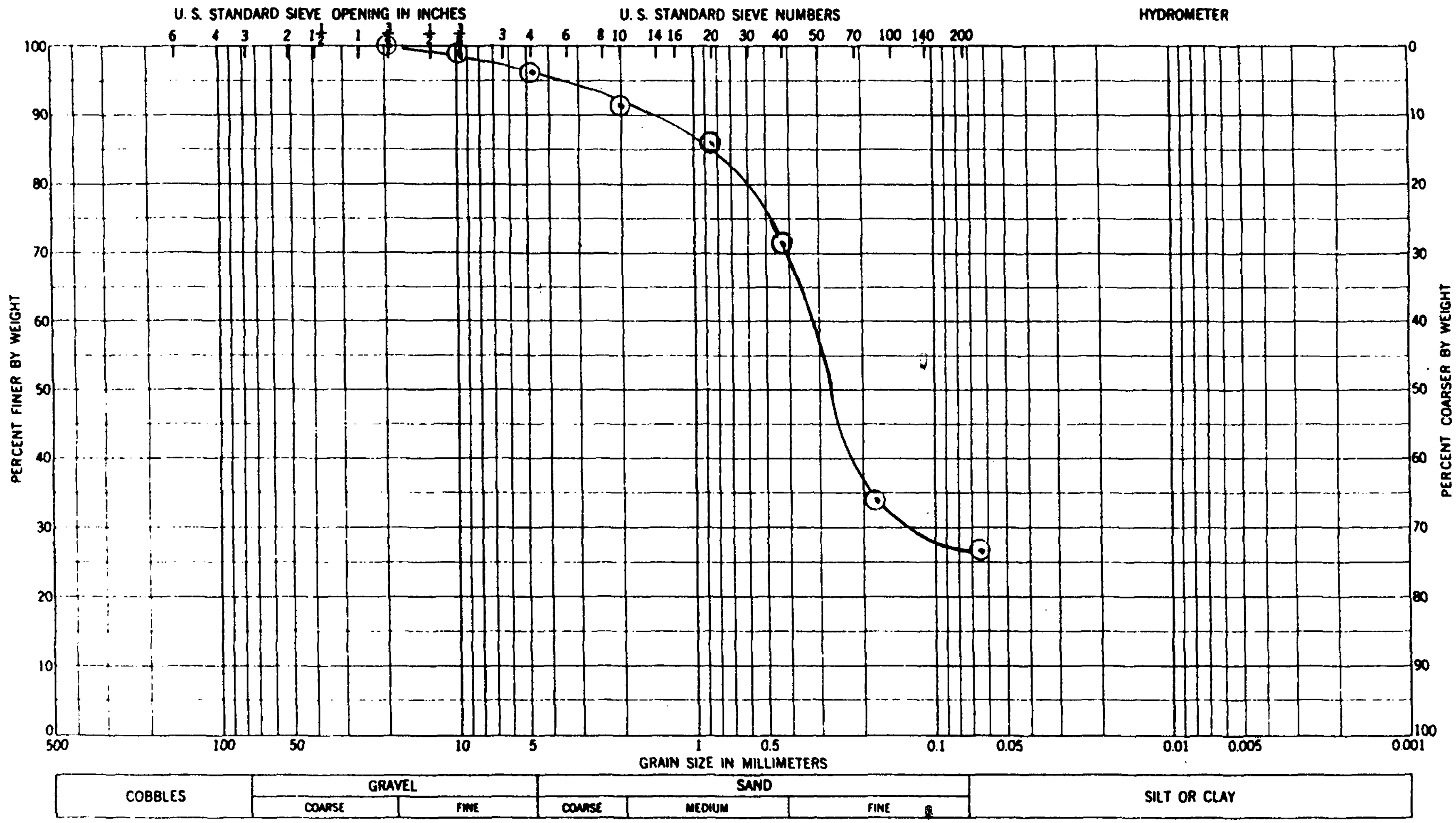
Date: 11/29/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087

C-13

C-14



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
D-1	0-0.7'	SILTY CLAYEY SAND (SM-SC)	5.7	19	13	6

Project: Himco Dump Superfund Site ELKHART, IN

Area

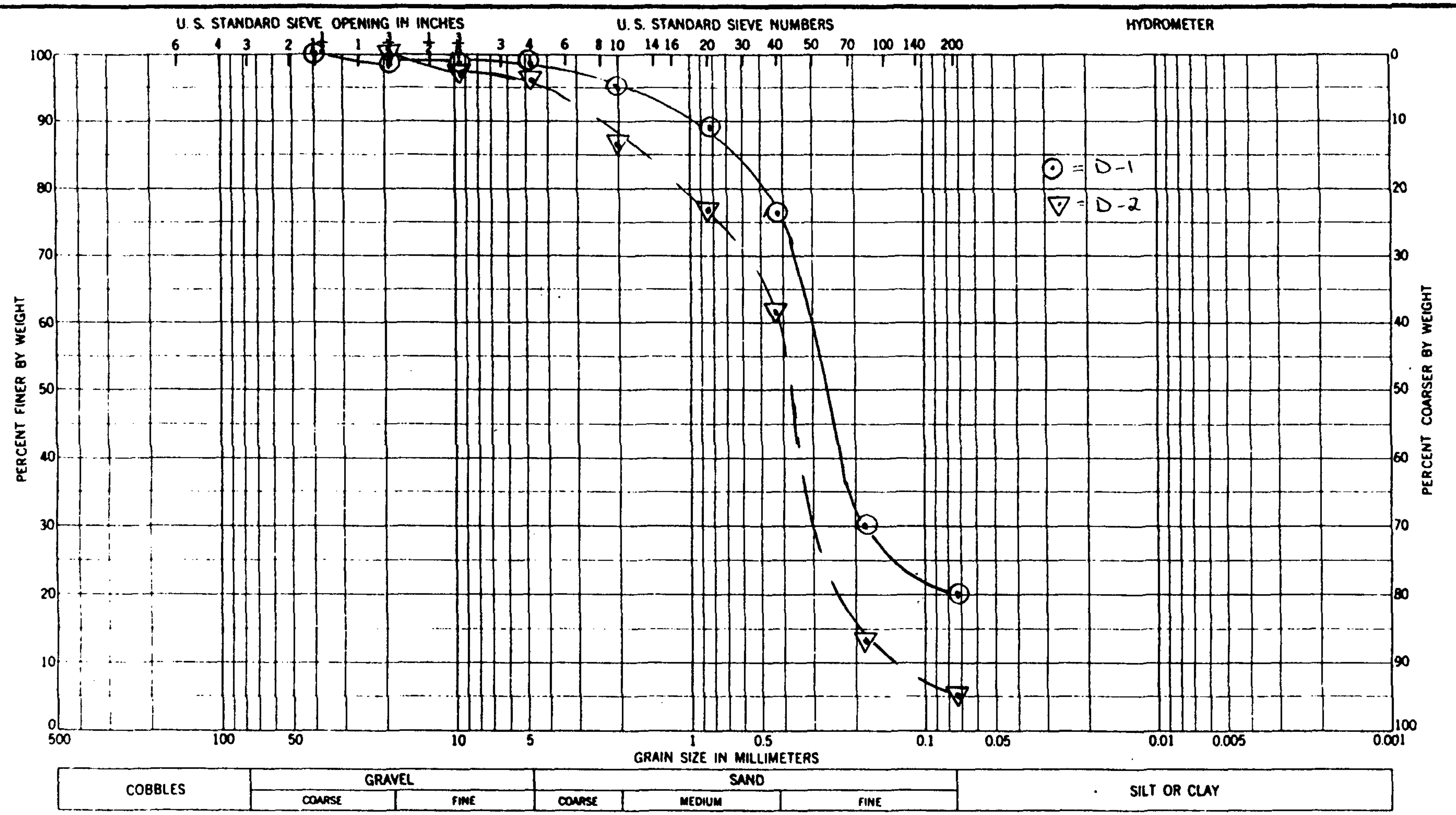
Boring No. A-2

Date 11/29/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087

C-15



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊙ D-1	0-0.5'	SILTY SAND (SM-SC)	5.1	16	12	4
▽ D-2	0.5-3.0'	SILTY SAND (SP-SM)	3.8			

Project: Himco Dump Superfund Site, Elkhart, IN.

Area:

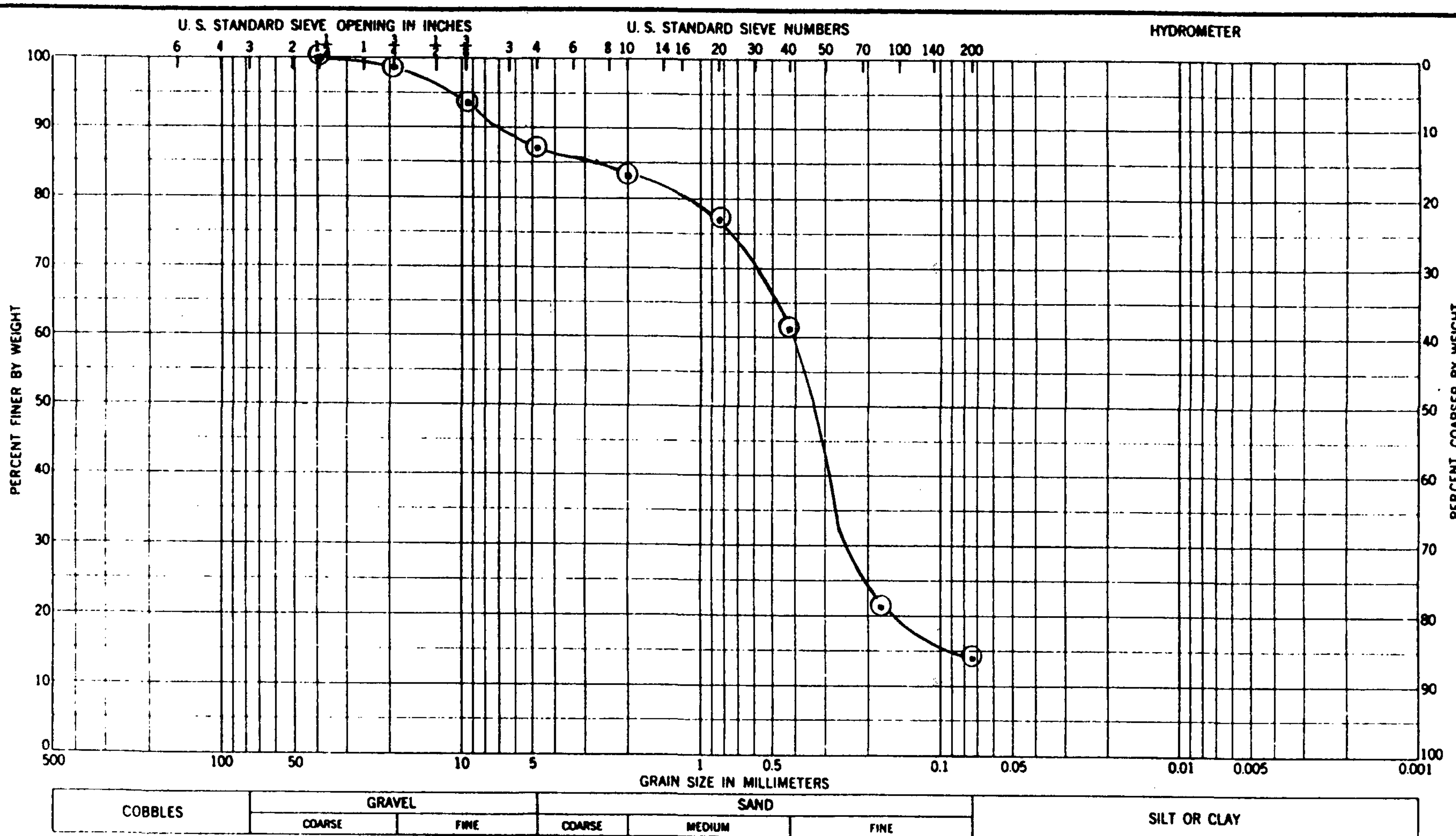
Boring No. A-3

Date 11/29/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087

C-16



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
D-1	0-0.5'	SILTY SAND w/ GRAVEL (SM)	2.4			

Project HIMCO DUMP SUPERFUND SITE ELKHART, IN.

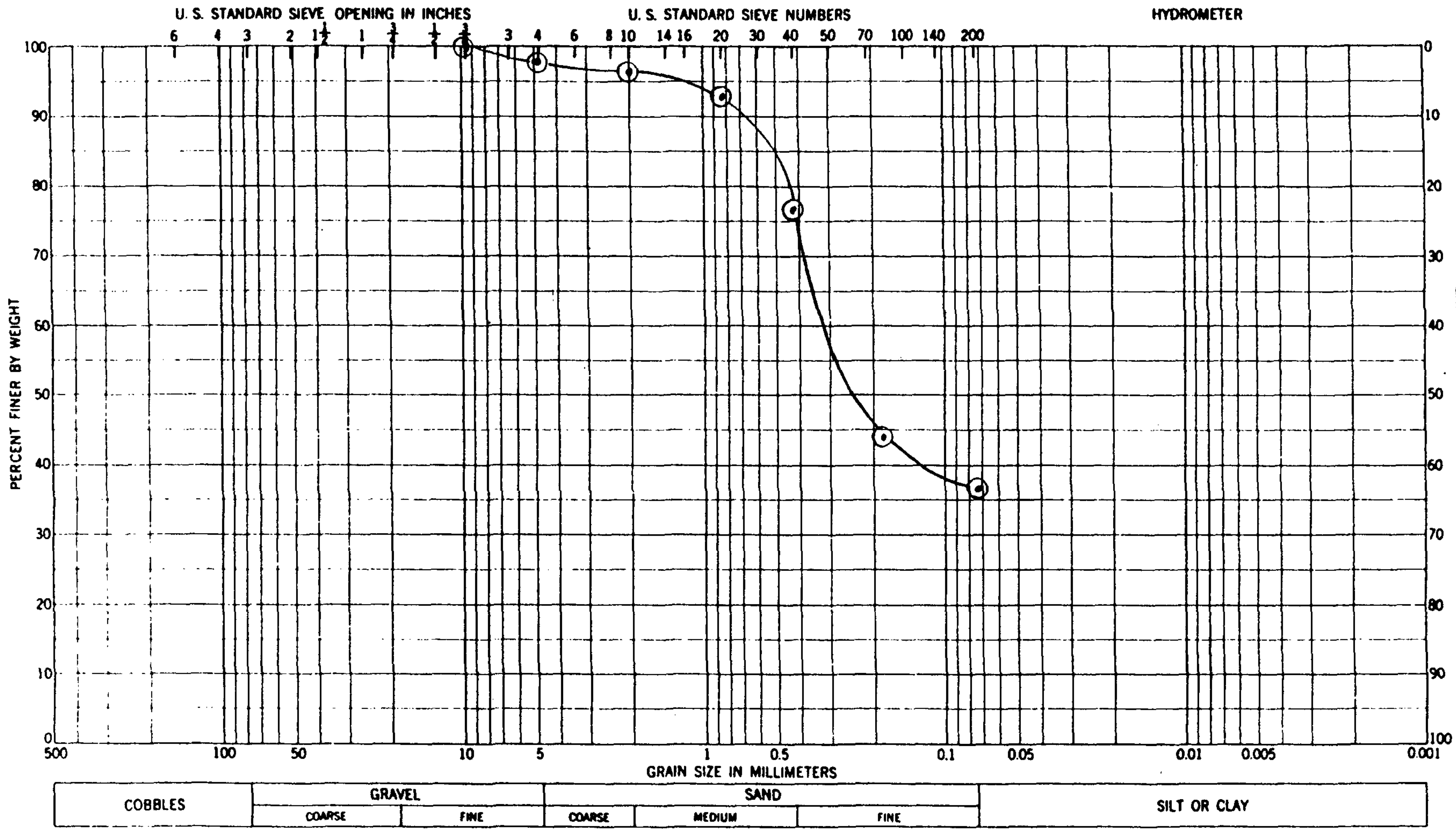
Area

Boring No. A-4

Date 11/29/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
D-1	0-1.0'	CLAYEY SAND (SC)	31.0	27	17	10

Project HIMCO DUMP SUPERFUND SITE
ELKHART, IN

Area

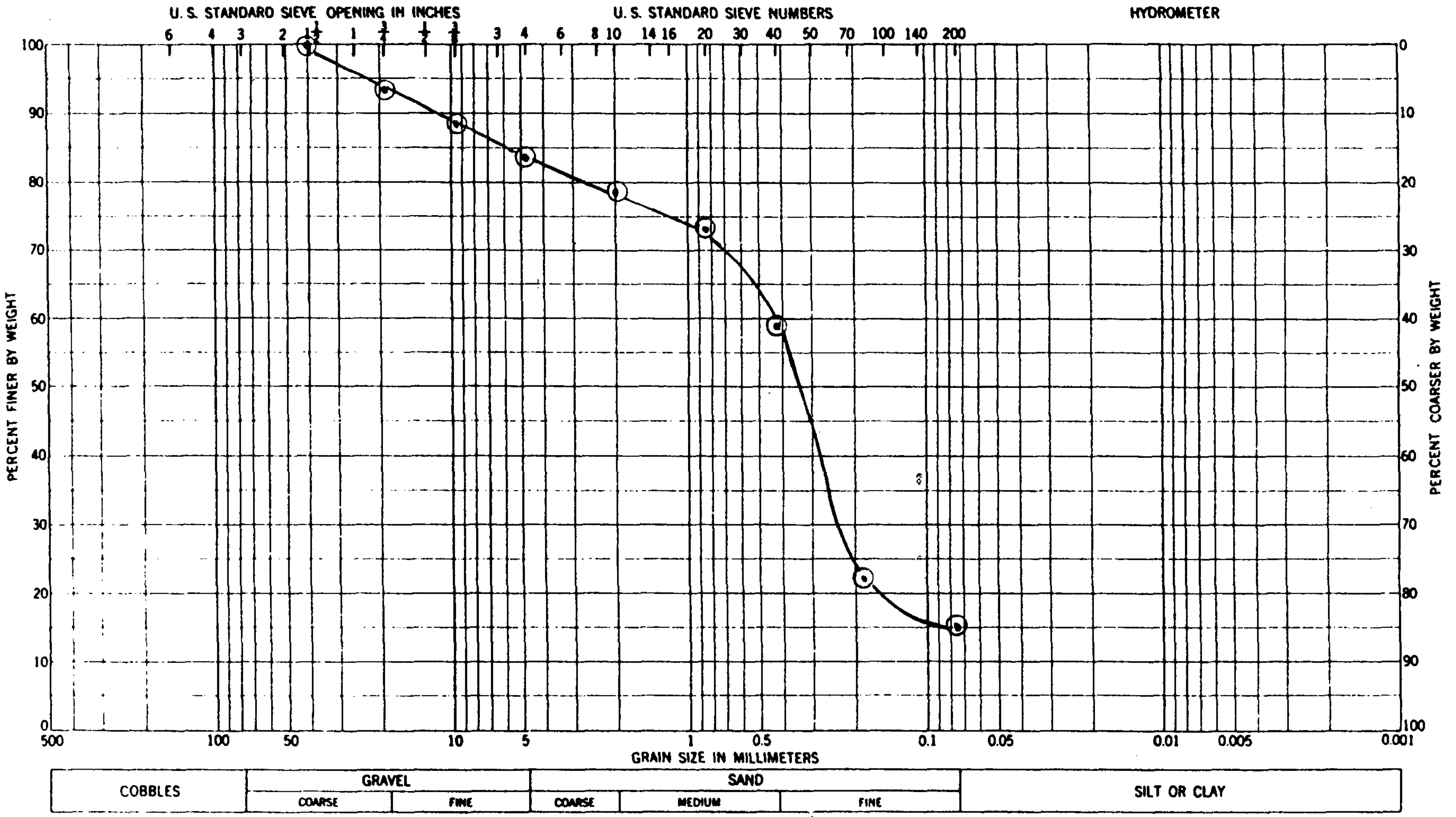
Boring No. A-5

Date 11/29/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087

C-18



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
D-1	0-0.5'	SILTY SAND (SM-SC)	4.3			

Project Himco Dump Superfund Site
ELKHART, IN.

Area

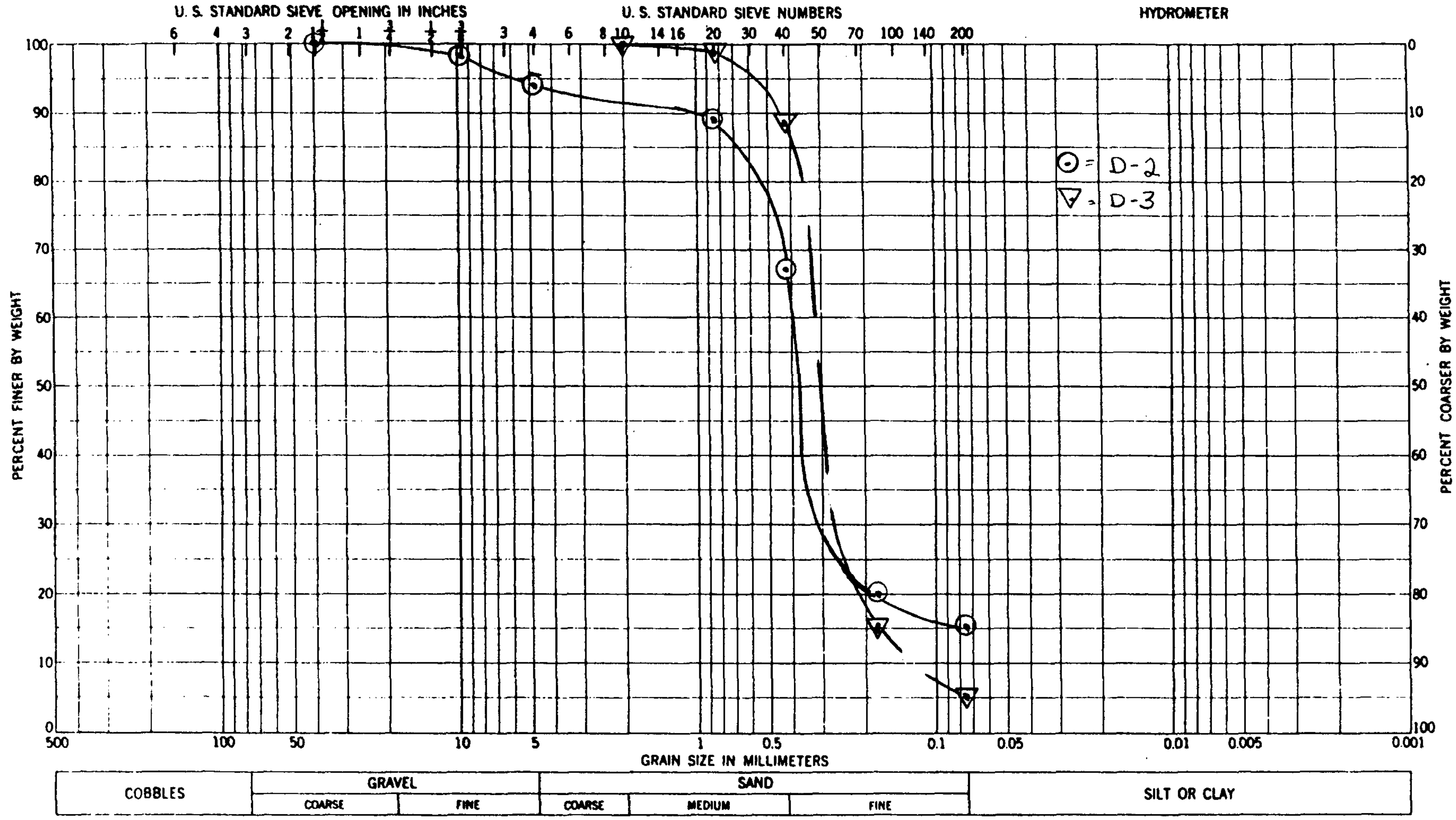
Boring No. A-6

Date 11/29/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087

C-19



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊙ D-2	0.7-1.0'	SILTY SAND (SM)	8.2			
▽ D-3	2.5-3.0'	SILTY SAND (SP-SM)	12.4			

Project HIMCO DUMP SUPERFUND SITE
ELKHART, IN

Area

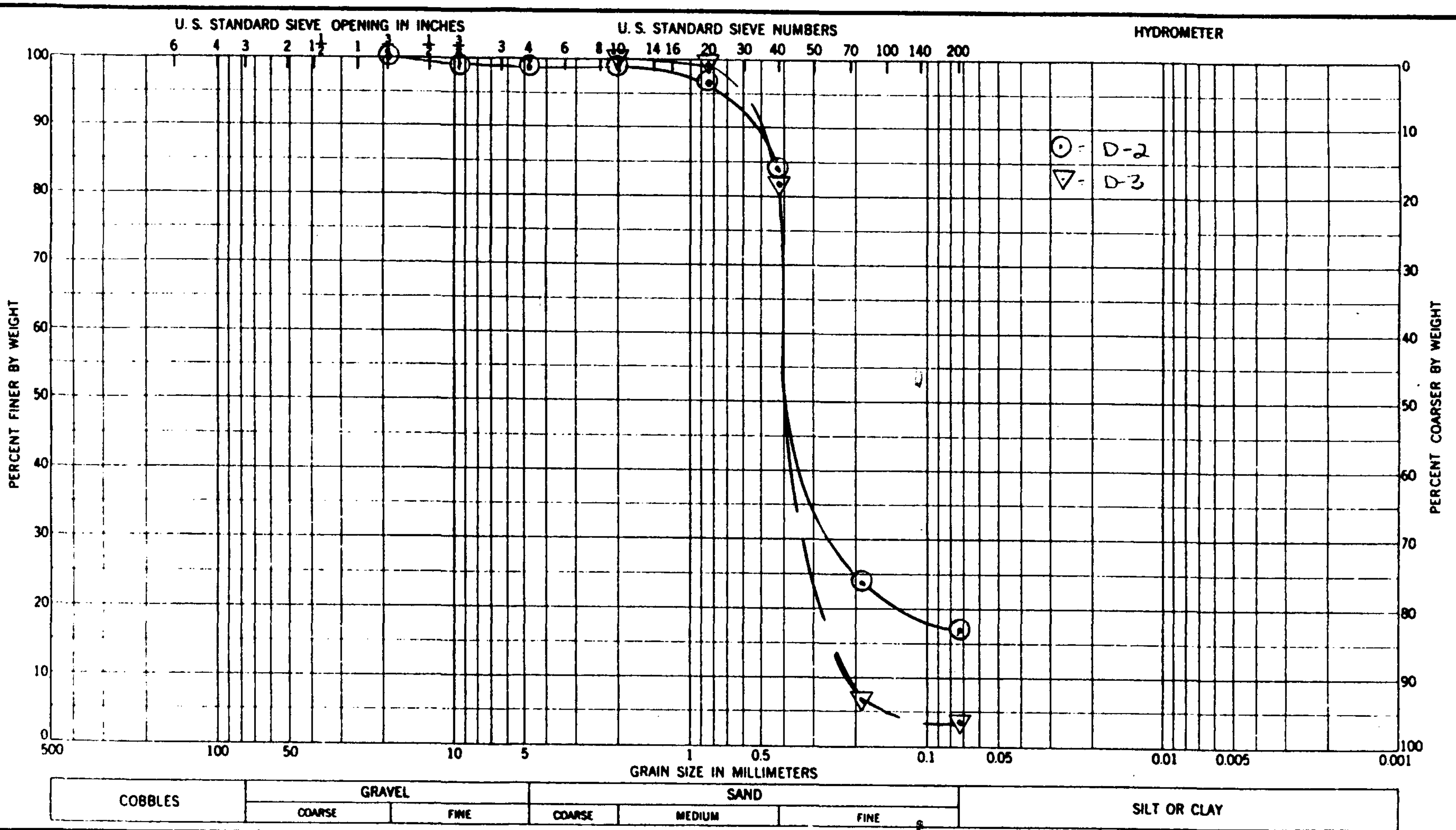
Boring No. A-10

Date 11/29/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087

C-20



	Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊙	D-2	0.5-1.0'	SILTY SAND (SM)				
▽	D-3	2.5-3.0'	SAND (SP)				

Project: Himco Dump Superfund Site, Elkhart, IN

Area:

Boring No. A-12

Date: 11/29/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY
Missouri River Division, Corps of Engineers
Division Laboratory
Omaha, Nebraska

TABLE 1 - SUMMARY OF CLASSIFICATION TESTS

Project: HIMCO Superfund Site MRD Lab No. 3584

Holes B-9, B-10 and B-11

Note: By visual examination and classification, samples not tested were compared and grouped with typical test samples described below:

(a) Silty Sand with some gravel SW-SM. Light Brown. Fine sand to fine gravel. Nonplastic. Similar to Hole B-9, Sample 1 (7.6% Fines, 77.6% Sand, 14.8% Gravel; Cu-6.55, Cc-1.11).

(b) Silty Sand SP-SM. Black and Brown. Fine to medium sand. Nonplastic. Similar to Hole B-9, Sample 2 (5.2% Fines, 90.4% Sand, 4.4% Gravel; Cu-3.13, Cc-1.36).

(c) Silty Sand SP-SM. Brown with White. Fine to coarse sand. Nonplastic. Similar to Hole B-9, Sample 3 (5.4% Fines, 88.4% Sand, 6.2% Gravel; Cu-3, Cc-0.75).

(d) Sand SP. Brown. Fine sand. Nonplastic. Similar to Hole B-9, Sample 4 (3.9% Fines, 95.7% Sand, 0.4% Gravel; Cu-2.85, Cc-1.36).

(e) Silty Sand SM. Dark Brown. Fine to medium sand. Nonplastic. Similar to Hole B-10, Sample 1 (26% Fines, 69.5% Sand, 4.5% Gravel).

(f) Silty Sand SM. Rust and Brown. Fine to medium sand. Nonplastic. Similar to Hole B-10, Sample 2 (13.3% Fines, 83.7% Sand, 3% Gravel).

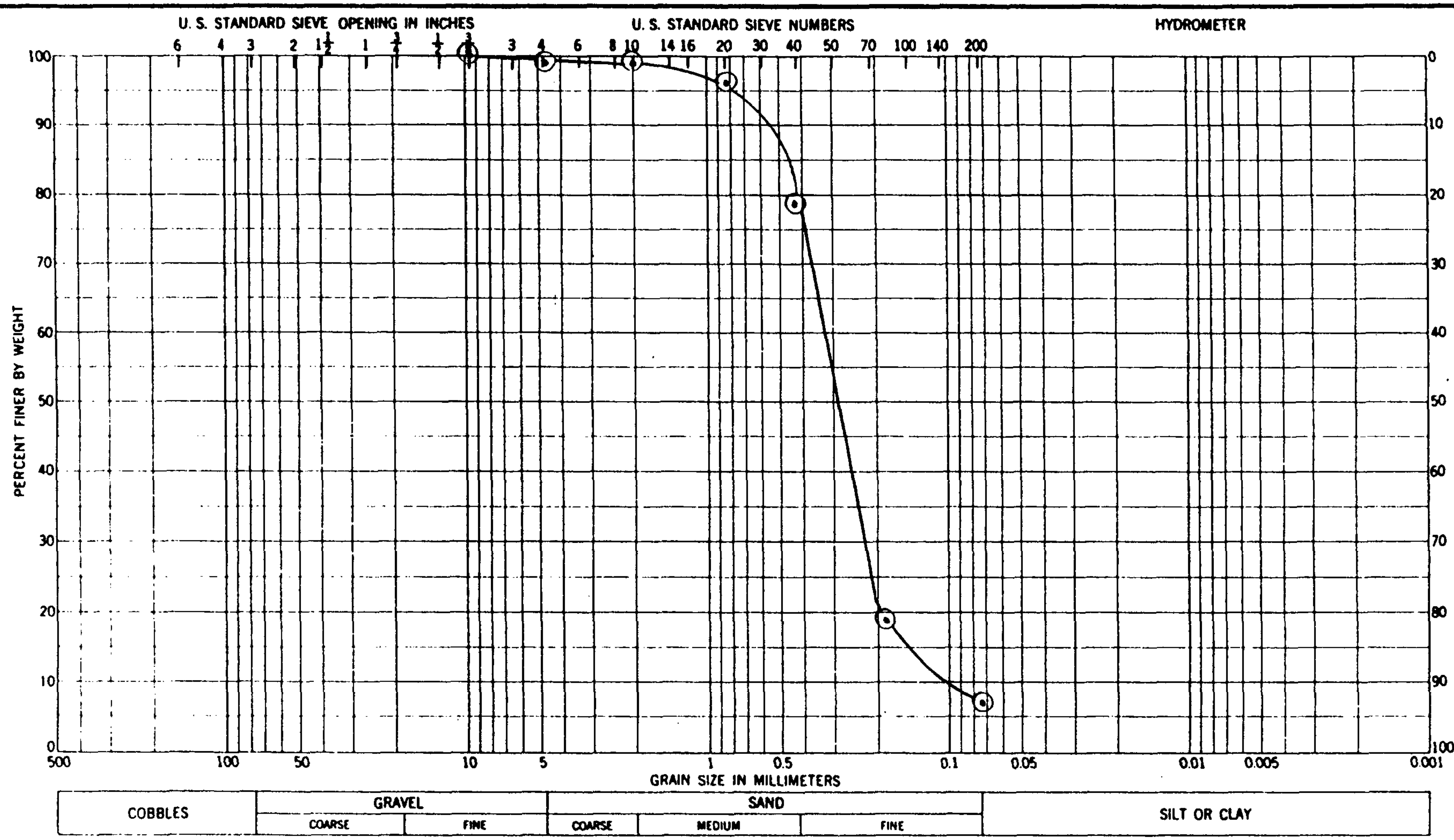
(g) Sand SP. Yellowish Brown. Fine to medium sand. Nonplastic. Similar to Hole B-10, Sample 3 (0.6% Fines, 99.2% Sand, 0.2% Gravel; Cu-2.1, Cc-0.86).

(h) Silty Sand SP-SM. Rust. Fine to medium sand. Nonplastic. Similar to Hole B-11, Sample 1 (7.4% Fines, 91.8% Sand, 0.8% Gravel; Cu-3.58, Cc-1.5).

SOIL CLASSIFICATION RECORD SHEET

HIMCO Superfund Site

	DEPTH TO BOTTOM OF SAMP	MOIST-URE (%)	PLASTICITY (ATT. LIMITS) LL	PI	GRADING (CUMULATIVE PERCENTS FINER) YSIS 200	U.S. STANDARD SIEVE SIZE SANDS 80	40	20	10	4	3/8	CLASSIFICATION TECH MEMO 3-357, MAY 67	REMARKS
Hole	B-9												
1	2.5				8	12	39	62	76	85	94	Silty Sand w/ gravel SW-SM	Note (a)
2	3.0				5	19	82	91	94	96	97	Silty Sand SP-SM	Note (b)
3	6.8				5	9	51	72	87	94	98	Silty Sand SP-SM	Note (c)
4	7.5				4	22	92	98	99	100	100	Sand SP	Note (d)
Hole	B-10												
1	1.2				26	37	81	91	93	96	97	Silty Sand SM	Note (e)
2	5.0				13	33	89	94	95	97	98	Silty Sand SM	Note (f)
3	10.0				1	6	64	98	100	100	100	Sand SP	Note (g)
Hole	B-11												
[illegible]	5.0				7	19	78	96	99	99	100	Silty Sand SP-SM	Note (h)
2	8.0											Sand SP	Note (g)



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
D-1		Silty Sand (SP-SM)				

Project Himco Dump Superfund Site
Elkhart, IN

Area

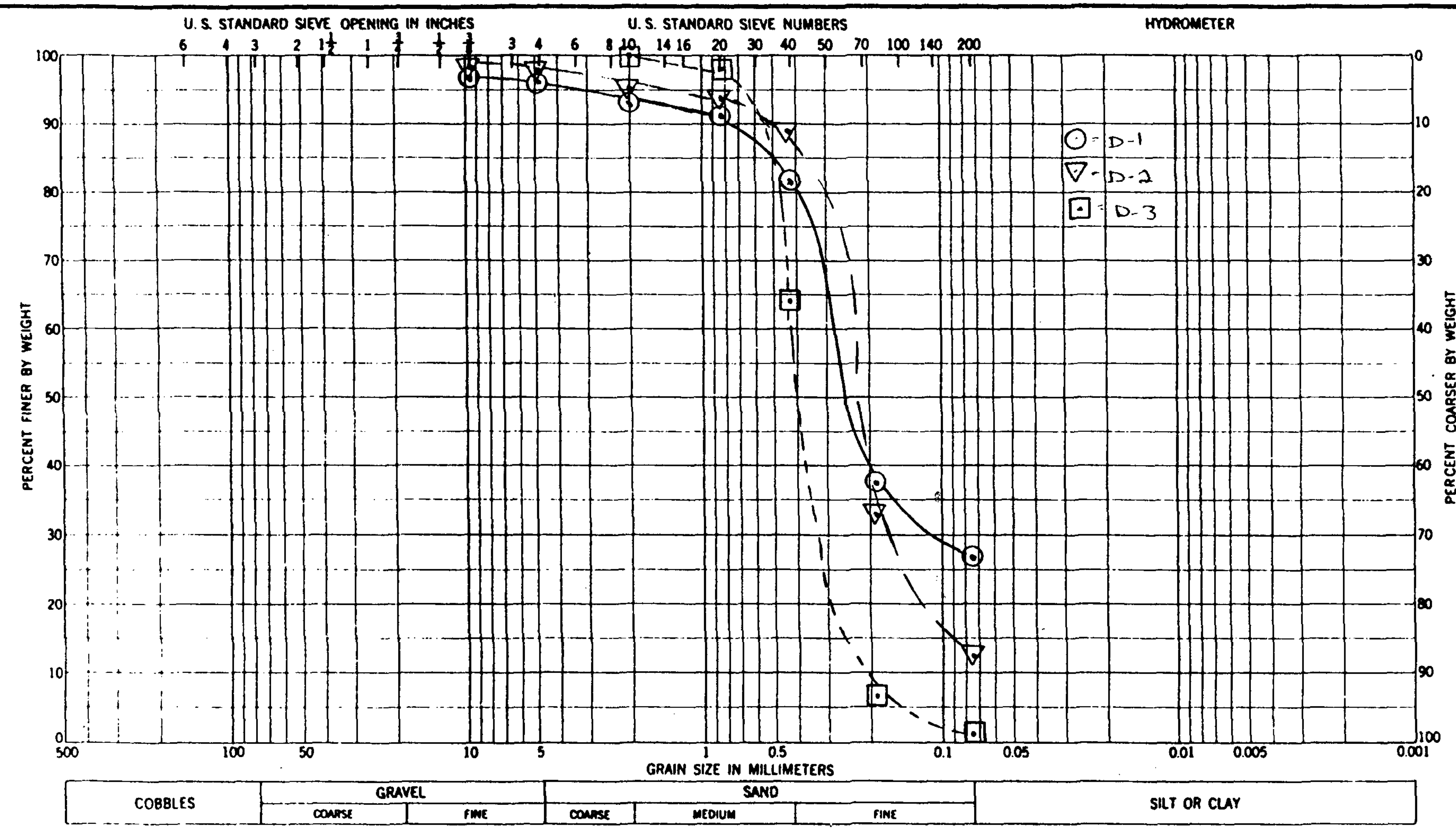
Boring No. B-11

Date 11/30/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087

C-24



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊙ D-1		SILTY SAND (SM)				
▽ D-2		SILTY SAND (SM)				
⊡ D-3		SAND (SP)				

Project: Himco Dump Superfund Site
ELKHART, IN

Area:

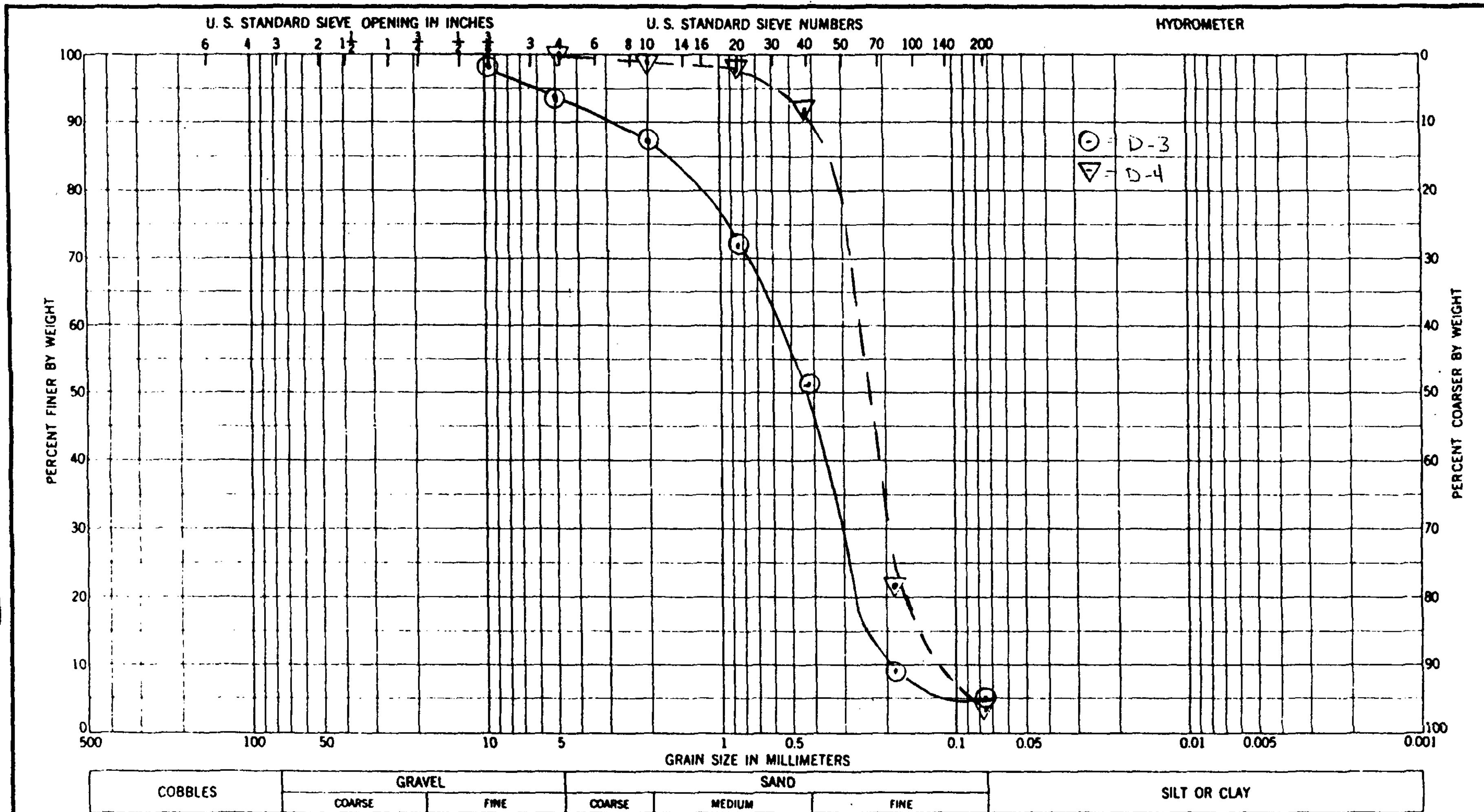
Boring No. B-10

Date 11/30/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087

C-25



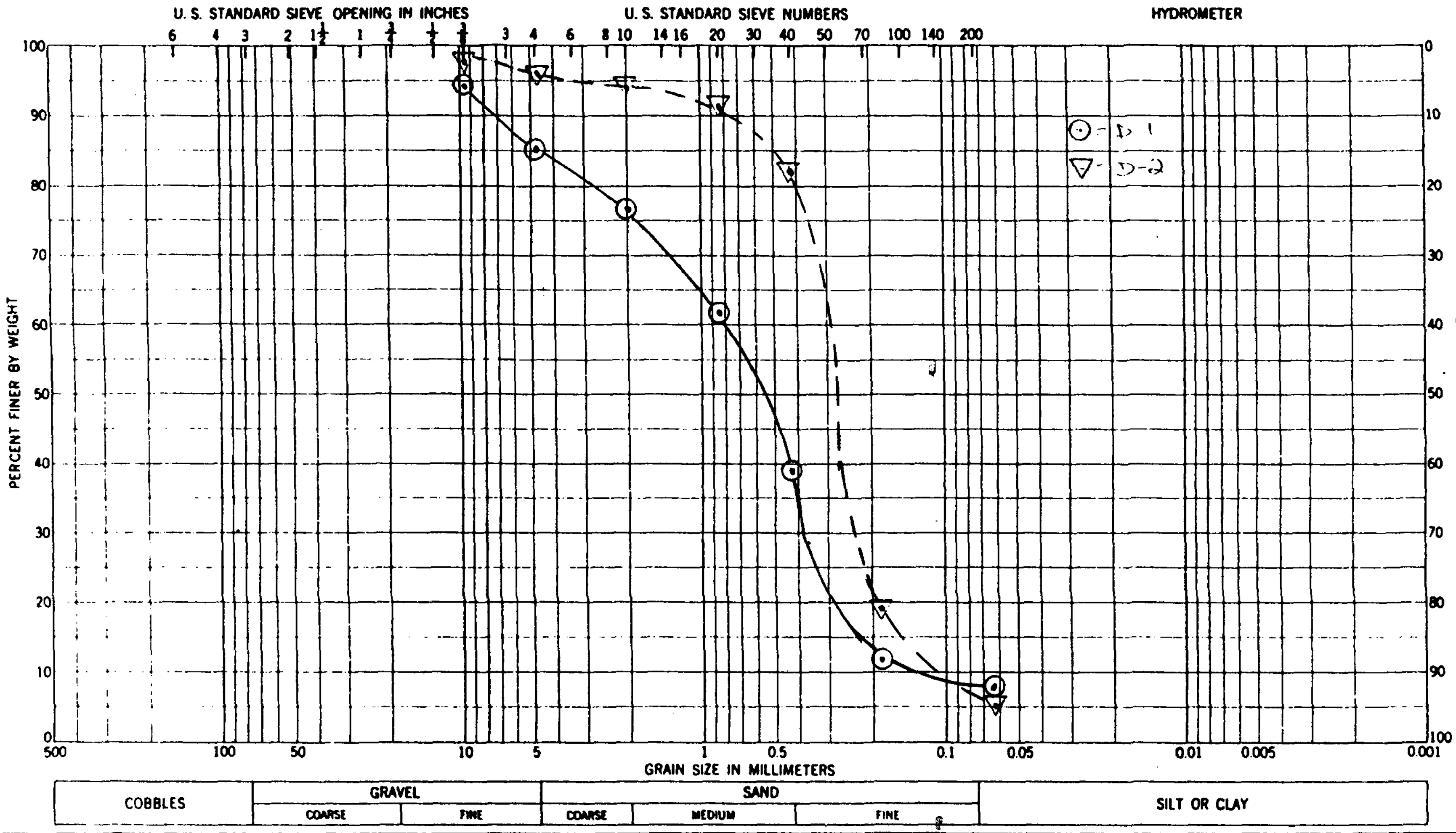
Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊙ D-3		Silty Sand (SP-SM)				
▽ D-4		Sand (SP)				

Project: Himco Dump Superfund Site
Elkhart [illegible]
Area
Boring No. B-9
Date 11/30/95

GRADATION CURVES

ENG FORM 1 MAY 63 2087

92-7



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊙ D-1		Silty Sand w/ Gravel (SW-SM)				
▽ D-2		Silty Sand (SP-SM)				

Project Himco Dump Superfund Site
Elkhart, IN
Area
Boring No. B-7
Date 1/27/75

GRADATION CURVES

ENG FORM 1 MAY 63 2087

APPENDIX D

REMEDIAL ACTION
HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX D
USACE DRILLING LOGS

HTW DRILLING LOG

HOLE NO.	WT112A
COMPANY NAME	U.S. ARMY CORPS OF ENGINEERS
2. DRILLING SUBCONTRACTOR	N/A
SHEET 1 OF 3 SHEETS	
3. PROJECT	HIMCO DUMP SUPERFUND SITE
4. LOCATION	ELKHART, IN.
5. NAME OF DRILLER	JOE MORRISSEY
6. MANUFACTURER'S DESIGNATION OF DRILL	GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4 1/4" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU P1101PID; ISTMX 410 CGI.
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-23-95
11. DATE COMPLETED	8-23-95
12. OVERBURDEN THICKNESS	UNKNOWN
15. DEPTH GROUNDWATER ENCOUNTERED	9.5'
13. DEPTH DRILLED INTO ROCK	N/A
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	8-24-95 9:56 AM 8.5'
14. TOTAL DEPTH OF HOLE	16.0'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0		BACKGROUND HNU = 2.8 UNITS O_2 = 20.9% LEL = 0%				
	1						
	2						
	3						
		POORLY GRADED SAND (SP): MEDIUM DENSE, MOIST, TAN, MEDIUM TO COARSE SAND, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 3.3 UNITS O_2 = 20.8% LEL = 0%			4	N = 12 REC. = 1.5'
	4					5	
						7	
	5						

HTW DRILLING LOG

HOLE NO.
WT112A

PROJECT	INSPECTOR	SHEET 2 OF 3 SHEETS
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6						
	7						
	8						
		WELL GRADED GRAVEL WITH SAND (GW): MEDIUM DENSE, MOIST, TAN, 20% MEDIUM TO COARSE SAND, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 3.0 UNITS O_2 = 20.9% LEL = 0%			4	N = 16 REC. = 1.4'
	9					7	10:07 AM WATER @ 9.5'
▽						9	
	10						
	11						
	12						
	13						
		WELL GRADED SAND WITH GRAVEL (SW): WET, BROWN, 15%-20% GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 3.0 UNITS O_2 = 20.9% LEL = 0%	D-1		13	N = 127 REC. = 1.5'
	14					67	

HTW DRILLING LOG

PROJECT	INSPECTOR	HOLE NO.	SHEET
[illegible]CO DUMP SUPERFUND SITE	MICHELLE BENAK	WT112A	SHEET 3 OF 3 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	15		D-1			60	SPLIT SPOON SAMPLER WAS FULL. POSSIBLY CAUSING ARTIFICIALLY HIGH BLOW COUNTS.
	16	BOTTOM OF HOLE @ 16.0'					
	17						

HTW DRILLING LOG

HOLE NO.	WT112B
1. COMPANY NAME	U.S. ARMY CORPS OF ENGINEERS
2. DRILLING SUBCONTRACTOR	N/A
SHEET 1 OF 7 SHEETS	
3. PROJECT	HIMCO DUMP SUPERFUND SITE
4. LOCATION	ELKHART, IN.
5. NAME OF DRILLER	JOE MORRISSEY
6. MANUFACTURER'S DESIGNATION OF DRILL	GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	6 1/4" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU PI101 PID; ISTMX 410 CGI.
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-23-95
11. DATE COMPLETED	8-23-95
12. OVERBURDEN THICKNESS	UNKNOWN
13. DEPTH DRILLED INTO ROCK	N/A
14. TOTAL DEPTH OF HOLE	59.3'
15. DEPTH GROUNDWATER ENCOUNTERED	SEE LOG OF WT112A
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	8-24-95 9:58AM 8.8'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	SEE LOG OF BORING FOR WT112A FOR A DESCRIPTION OF MATERIALS DOWN TO 15' BELOW GROUND SURFACE.	BACKGROUND HNU = 2.8 UNITS O_2 = 20.9% LEL = 0%				AUGERED TO 18.5' AND OBTAINED FIRST SAMPLE FROM 18.5'-20.0' AND EVERY 5' THEREAFTER
	1						
	2						
	3						
	4						
	5						

PROJECT	HOLE NO.
HIMCO DUMP SUPERFUND SITE	WT112B

D-5

HTW DRILLING LOG

PROJECT	INSPECTOR	HOLE NO.	SHEET
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	WT112B	SHEET 2 OF 7 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						

HTW DRILLING LOG

HOLE NO.
WT112B

PROJECT	INSPECTOR	SHEET 3 OF 7 SHEETS
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	15						
	16						
	17						
	18						
		WELL GRADED GRAVEL (GW): WET, BROWN TO LIGHT BROWN, FINE TO COARSE GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 3.4 UNITS O_2 = 20.9% LEL = 0%			4	N = 27 REC. = 1.5′
	19	POORLY GRADED SAND (SP): WET, TAN, FINE TO MEDIUM SAND WITH APPROXIMATELY 10% GRAVEL. OUTWASH DEPOSITS.				10	
		WELL GRADED GRAVEL (GW): SAME AS THE INTERVAL FROM 18.5′-18.9′.				17	
	20						
	21						
	22						
	23						
		WELL GRADED GRAVEL (GW): SAME AS THE INTERVAL FROM 18.5′-18.9′ EXCEPT MEDIUM DENSE: GRAVEL UP TO 1½" IN DIAMETER.				6	
	24						

HTW DRILLING LOG

HOLE NO.
WT112B

PROJECT	INSPECTOR	SHEET 4
[CO] DUMP SUPERFUND SITE	MICHELLE BENAK	OF 7 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
		POORLY GRADED SAND WITH GRAVEL (SP): MEDIUM DENSE, WET, MEDIUM GRAINED SAND, 20%-25% GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 3.2 UNITS O_2 = 20.9% LEL = 0%			9	N = 19 REC. = 0.8'
						10	
	25						
	26						
	27						
	28						
		POORLY GRADED SAND WITH GRAVEL (SP): SAME AS THE INTERVAL FROM 23.9'-25.0' EXCEPT DENSE, 20% GRAVEL.	BREATHING ZONE HNU = 3.2 UNITS O_2 = 20.9% LEL = 0%			5	N = 36 REC. = 1.5'
	29					12	
						24	
	30						
	31						
	32						
	33						

HTW DRILLING LOG

HOLE NO.	SHEET	OF
WT112B	5	7 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	34	POORLY GRADED SAND WITH GRAVEL (SP): SAME AS THE INTERVAL FROM 23.9'-25.0'.	BREATHING ZONE HNU = 3.0 UNITS O_2 = 20.9% LEL = 0%			6 12 14	N = 26 REC. = 1.2'
	35						
	36						
	37						
	38						
	39	POORLY GRADED SAND WITH GRAVEL (SP): SAME AS THE INTERVAL FROM 23.9'-25.0' EXCEPT BROWN, 35%-40% GRAVEL UP TO 1½" IN DIAMETER.	BREATHING ZONE HNU = 3.4 UNITS O_2 = 20.9% LEL = 0%			35 16 13	N = 29 REC. = 0.4'
	40						
	41						
	42						
	43						

HTW DRILLING LOG

HOLE NO.	SHEET
WT112B	6 of 7 SHEETS

PROJECT	INSPECTOR
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	44	POORLY GRADED SAND WITH GRAVEL (SP): SAME AS THE INTERAL FROM 23.9'-25.0' EXCEPT GRAVEL UP TO 1½" IN DIAMETER.	BREATHING ZONE HNU = 3.4 UNITS O_2 = 20.9% LEL = 0%			21 16 7	N = 23 REC. = 1.2'
	45						
	46						
	47						
	48						
	49	POORLY GRADED SAND (SP): VERY DENSE, WET, BROWN, FINE SAND. OUTWASH DEPOSITS.	BREATHING ZONE HNU = 3.0 UNITS O_2 = 20.9% LEL = 0%			15 16 36	N = 52 REC. = 1.2'
	50						
	51						
	52						

HTW DRILLING LOG

HOLE NO.	SHEET	PROJECT	INSPECTOR
WT112B	7 OF 7 SHEETS	HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	53						
		POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 49.2'-50.0'.	BREATHING ZONE HNU = 3.2 UNITS O_2 = 20.9% LEL = 0%			13	N = 62 REC. = 1.5'
	54	POORLY GRADED SAND WITH GRAVEL (SP): VERY DENSE, WET, 25%-30% GRAVEL UP TO 1½" IN DIAMETER, OUTWASH DEPOSITS.				23	
						39	
	55						
	56						
	57						
	58						
		POORLY GRADED SAND (SP): VERY DENSE, WET, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 2.8 UNITS O_2 = 20.9% LEL = 0%	D-1		11	N = 89 (ONE 6" INTERVAL ONLY) REC. = 0.8'
	59					89	
		BOTTOM OF HOLE @ 59.3'					CLEANED HOLE OUT WITH AUGERS TO 60.0', THEN SET MONITORING WELL IN BORING.
	60						

HTW DRILLING LOG

HOLE NO. WT113A

COMPANY NAME: U.S. ARMY CORPS OF ENGINEERS	2. DRILLING SUBCONTRACTOR: N/A	SHEET 1 OF 1 SHEETS
PROJECT: HIMCO DUMP SUPERFUND SITE	4. LOCATION: ELKHART, IN.	
5. NAME OF DRILLER: JOE MORRISSEY	6. MANUFACTURER'S DESIGNATION OF DRILL: GUS PECH 1100C	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU P1101PID; ISTMX 410 CGI.	8. HOLE LOCATION:	
	9. SURFACE ELEVATION:	
	10. DATE STARTED: 8-10-95	11. DATE COMPLETED: 8-10-95
12. OVERBURDEN THICKNESS: UNKNOWN	15. DEPTH GROUNDWATER ENCOUNTERED: 16.5'	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 8-11-95 2:30 PM 15.75'	
14. TOTAL DEPTH OF HOLE: 23.7'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	SEE LOG OF BORING FOR WT113B FOR A DESCRIPTION OF MATERIALS.	BACKGROUND HNU = 1.0 UNITS O_2 = 20.9% LEL = 0%				AUGERED TO 23.7' AND SET A MONITORING WELL IN THE BORING.
	5		BREATHING ZONE HNU = 0.0 UNITS O_2 = 20.9% LEL = 0%				
	10						
	15		BREATHING ZONE HNU = 2.0 UNITS O_2 = 21.0% LEL = 0%				WATER @ 16.5'
	20						
		BOTTOM OF HOLE @ 23.7'					
	25						

PROJECT	HOLE NO.
HIMCO DUMP SUPERFUND SITE	WT113A

D-12

HTW DRILLING LOG

HOLE NO.	WT113B
1. COMPANY NAME	U.S. ARMY CORPS OF ENGINEERS
2. DRILLING SUBCONTRACTOR	N/A
SHEET 1 OF 8 SHEETS	
3. PROJECT	HIMCO DUMP SUPERFUND SITE
4. LOCATION	ELKHART, IN.
5. NAME OF DRILLER	JOE MORRISSEY
6. MANUFACTURER'S DESIGNATION OF DRILL	GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	6 1/4" I.D. HSA; 6" O.D. CME CONTINUOUS SAMPLER TO 23.5', THEN SWITCHED TO 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU PI101 PID; ISTMX 410 CGI.
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-9-95
11. DATE COMPLETED	8-10-95
12. OVERBURDEN THICKNESS	UNKNOWN
15. DEPTH GROUNDWATER ENCOUNTERED	16.8'
13. DEPTH DRILLED INTO ROCK	N/A
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	8-10-95 8:03 AM 16.3'. 8-11-95 2:15 PM 16.0'
14. TOTAL DEPTH OF HOLE	70.0'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	TOPSOIL: BROWN, ROOTS.	BACKGROUND HNU = 0.2 UNITS O_2 = 20.9% LEL = 0%				RUN #1 START 9:44 STOP 9:48 REC. = 5.0'
		POORLY GRADED SAND (SP): MOIST, LIGHT BROWN, FINE TO MEDIUM SAND, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 0.0 UNITS O_2 = 20.9% LEL = 0%				
	1						
	2						
	3						
	4						
	5						

HTW DRILLING LOG

HOLE NO.	SHEET	
WT113B	2	OF 8 SHEETS

PROJECT	INSPECTOR
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
		POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 0.5'-5.0' EXCEPT FINE TO COARSE SAND AND UP TO 10% GRAVEL.	BREATHING ZONE HNU = 0.2 UNITS O_2 = 21.0% LEL = 0%				RUN #2 START 9:52 STOP 9:56 REC. = 3.7'
	6						
	7						
	8						
	9						
	10		BREATHING ZONE HNU = 0.9 UNITS O_2 = 20.9% LEL = 0%				RUN #3 START 10:01 STOP 10:05
	11						
	12	WELL GRADED GRAVEL WITH SAND (GW): LIGHT BROWN, 65%-70% FINE TO COARSE GRAVEL, 30%-35% FINE TO COARSE SAND, OUTWASH DEPOSITS.					
	13						
	14						MEASURED HOLE @ 14' BELOW GROUND SURFACE AT THE END OF RUN #3.

HTW DRILLING LOG

HOLE NO.	SHEET
WT113B	3 OF 8 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	15	WELL GRADED GRAVEL WITH SAND (GW): SAME AS THE INTERVAL FROM 10.0'-15.0'.	BREATHING ZONE HNU = 0.2 UNITS O_2 = 20.9% LEL = 0%				RUN #4 START 10:12 STOP 10:16
	16						
▽							WATER @ 16.8'
	17						
			BREATHING ZONE HNU = 0.7 UNITS O_2 = 21.0% LEL = 0%				MEASURED HOLE @ 17.5' BELOW GROUND SURFACE AT THE END OF RUNWAY.
	18						
	19						
	20						RUN #5
			BREATHING ZONE HNU = 0.4 UNITS O_2 = 20.9% LEL = 0%				
	21						
	22						
	23						
	24	WELL GRADED GRAVEL WITH SAND (GW): SAME AS THE INTERVAL FROM 10.0'-15.0'.				40	

HTW DRILLING LOG

HOLE NO. WT113B

PROJECT: [illegible]CO DUMP SUPERFUND SITE | INSPECTOR: MICHELLE BENAK | SHEET 4 OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
						36	N = 139 REC. = 1.5'
						103	AUTOMATIC HAMMER APPARENTLY MELFUNCTIONED, PRODUCING ARTIFICIALLY HIGH BLOW COUNTS.
	25						
	26						
	27						
	28	POORLY GRADED SAND WITH GRAVEL (SP): MEDIUM DENSE, WET, BROWN, 15% GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 0.7 UNITS O_2 = 21.0% LEL = 0%			5	N = 18 REC. = 1.3'
	29					7	
						11	
	30						
	31						
	32						
	33						

HTW DRILLING LOG

HOLE NO. WT113B

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

SHEET 5 OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
		POORLY GRADED SAND WITH GRAVEL (SP): SAME AS THE INTERVAL FROM 28.5'-30.0' EXCEPT LOOSE.	BREATHING ZONE HNU = 1.4 UNITS O_2 = 20.9% LEL = 0%			1	N = 4 REC. = 0.5'
	34					1	
						3	
	35						
	36						
	37						
	38						
		WELL GRADED SAND (SW): LOOSE, WET, DARK TO LIGHT BROWN, 5% GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 1.4 UNITS O_2 = 20.9% LEL = 0%			1	N = 5 REC. = 1.4'
	39					1	
						4	
	40						
	41						
	42						
	43						

HTW DRILLING LOG

HOLE NO.
WT113B

PROJECT	INSPECTOR	SHEET 6
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
						9	N = 70 REC. = 1.5'
	44					20	
		WELL GRADED GRAVEL WITH SAND (GW): VERY DENSE, BROWN TO LIGHT BROWN, 80% FINE TO COARSE GRAVEL, 20% FINE TO COARSE SAND, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 1.4 UNITS O_2 = 20.9% LEL = 0%			50	
	45						
							MEASURED HOLE @ 45.6' B.O.H.
	46						
	47						
	48						
		WELL GRADED GRAVEL WITH SAND (GW): SAME AS THE INTERVAL FROM 44.2'-45.0' EXCEPT MEDIUM DENSE.	BREATHING ZONE HNU = 1.1 UNITS O_2 = 20.9% LEL = 0%			2	N = 25 REC. = 0.9'
	49					18	
						7	
	50						
	51						
	52						

HTW DRILLING LOG

HOLE NO. WT113B

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

SHEET 7 OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	53						
		WELL GRADED SAND (SW): SATURATED, DENSE, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 0.8 UNITS O_2 = 20.9% LEL = 0%			13	N = 49 REC. = 0.8′
	54					28	
						21	
	55						
	56						
	57						
	58						
		POORLY GRADED SAND (SP): MEDIUM DENSE, WET, GREY TO BROWN, 5% GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 0.4 UNITS O_2 = 20.9% LEL = 0%			1	N = 12 REC. = 1.5′
	59					2	
						10	
	60						
	61						
	62						

HTW DRILLING LOG

HOLE NO.
WT113B

PROJECT	INSPECTOR	SHEET 8
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	63						
	63.5	POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 58.5'-60.0' EXCEPT LOOSE.	BREATHING ZONE HNU = 0.4 UNITS O_2 = 20.9% LEL = 0%	D-1		2	N = 7 REC. = 1.5'
	64					2	
	64.5					5	
	65						
	66						
	67						
	68						
	68.5		BREATHING ZONE HNU = 2.1 UNITS O_2 = 20.9% LEL = 0%			2	N = 5 REC. = 0
	69					3	
	69.5					2	
	70	BOTTOM OF HOLE @ 70.0'					BOTTOM OF HOLE MEASURED AT 67.8' BELOW GROUND SURFACE UPON PULLING THE SPLIT SPOON SAMPLER.
	71						

HTW DRILLING LOG

HOLE NO.	WT114A
1. COMPANY NAME	U.S. ARMY CORPS OF ENGINEERS
2. DRILLING SUBCONTRACTOR	N/A
SHEET	1 OF 3 SHEETS
3. PROJECT	HIMCO DUMP SUPERFUND SITE
4. LOCATION	ELKHART, IN.
5. NAME OF DRILLER	JOE MORRISSEY
6. MANUFACTURER'S DESIGNATION OF DRILL	GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4 1/4" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU PI101PID; ISTMX 410 CGI.
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-21-95
11. DATE COMPLETED	8-21-95
12. OVERBURDEN THICKNESS	UNKNOWN
15. DEPTH GROUNDWATER ENCOUNTERED	16.0'
13. DEPTH DRILLED INTO ROCK	N/A
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	8-22-95 7:47 AM 15.1'
14. TOTAL DEPTH OF HOLE	23.0'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0		BACKGROUND HNU = 0.6 UNITS O_2 = 20.9% LEL = 0%				
	1						
	2						
	3						
		POORLY GRADED SAND (SP): LOOSE MOIST, TAN, MEDIUM TO COARSE SAND, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 0.2 UNITS O_2 = 20.9% LEL = 0%			3	N = 6 REC. = 1.3'
	4					3	
						3	
	5						

HTW DRILLING LOG

HOLE NO.	SHEET	PROJECT	INSPECTOR
WT114A	2 OF 3 SHEETS	HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6						
	7						
	8						
		POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 3.5'-5.0' EXCEPT RUST COLOR, COARSER SAND.	BREATHING ZONE HNU = 0.2 UNITS O_2 = 20.9% LEL = 0%			3	N = 9 REC. = 1.4'
	9					4	
						5	
	10						
	11						
	12						
	13						
		POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 3.5'-5.0' EXCEPT LIGHT BROWN, COARSER SAND.	BREATHING ZONE HNU = 0.1 UNITS O_2 = 21.0% LEL = 0%			3	N = 7 REC. = 1.5'
	14					3	

HTW DRILLING LOG

HOLE NO.
WT114A
SHEET 3 OF 3 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
						4	
	15						
∇	16						WATER @ 16.0'
	17						
	18						
	18.5	POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 3.5'-5.0' EXCEPT MEDIUM DENSE, WET, BROWN, 10% GRAVEL.		D-1		4	N = 25 REC. = 1.5'
	19					8	
						17	
	20						
	21						
	22						
	23	BOTTOM OF HOLE @ 23.0'					
	24						

HTW DRILLING LOG

HOLE NO.	WT114B
SHEET 1 OF 8 SHEETS	
1. COMPANY NAME	U.S. ARMY CORPS OF ENGINEERS
2. DRILLING SUBCONTRACTOR	N/A
3. PROJECT	HIMCO DUMP SUPERFUND SITE
4. LOCATION	ELKHART, IN.
5. NAME OF DRILLER	JOE MORRISSEY
6. MANUFACTURER'S DESIGNATION OF DRILL	GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	6 1/4" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU P1101 PID; 1STMX 410 CGI.
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-22-95
11. DATE COMPLETED	8-22-95
12. OVERBURDEN THICKNESS	UNKNOWN
13. DEPTH DRILLED INTO ROCK	N/A
14. TOTAL DEPTH OF HOLE	66.0'
15. DEPTH GROUNDWATER ENCOUNTERED	SEE LOG OF WT114A
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	8-23-95 9:00AM 15.2'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	SEE LOG OF BORING FOR WT114A FOR A DESCRIPTION OF MATERIALS DOWN TO 20.0' BELOW GROUND SURFACE.	BACKGROUND HNU = 0.8 UNITS O_2 = 20.9% LEL = 0%				AUGERED TO 23.5' AND OBTAINED FIRST SAMPLE FROM 23.5'-25.0' AND EVERY 5' THEREAFTER.
	1						
	2						
	3						
	4						
	5						

HTW DRILLING LOG

HOLE NO.
WT114B

PROJECT	INSPECTOR	SHEET 2
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						

HTW DRILLING LOG

HOLE NO.
WT114B

PROJECT	INSPECTOR	SHEET 3
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23		BREATHING ZONE HNU = 4.0 UNITS O_2 = 20.9% LEL = 0%				
	24	POORLY GRADED SAND (SP): MEDIUM DENSE, WET, BROWN, TRACE OF GRAVEL, OUTWASH DEPOSITS.				1	

HTW DRILLING LOG

HOLE NO. WT114B

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

SHEET 4 OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
						6	N = 21 REC. = 1.5'
						15	
	25						
	26						
	27						
	28						
		POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 23.5'-25.0'.	BREATHING ZONE HNU = 5.2 UNITS O_2 = 20.8% LEL = 0%			2	N = 13 REC. = 1.2'
	29	WELL GRADED SAND (SW): MEDIUM DENSE, WET, BROWN, MEDIUM TO COARSE SAND, 10%-15% FINE GRAVEL, OUTWASH DEPOSITS.				4	
						9	
	30						
	31						
	32						
	33						

HTW DRILLING LOG

PROJECT	INSPECTOR	HOLE NO.
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	WT114B
		SHEET 5 OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	34	POORLY GRADED SAND WITH GRAVEL (SP): DENSE, WET, MEDIUM TO COARSE SAND, 20%-25% FINE TO COARSE GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 5.2 UNITS O_2 = 20.7% LEL = 0%			24 17 14	N = 31 REC. = 1.0'
	35						
	36						
	37						
	38						
	39	POORLY GRADED SAND WITH GRAVEL (SP): SAME AS THE INTERVAL FROM 33.5'-35.0' EXCEPT MEDIUM DENSE.	BREATHING ZONE HNU = 5.0 UNITS O_2 = 20.8% LEL = 0%			3 3 8	N = 11 REC. = 0.4'
	40						
	41						
	42						
	43						

HTW DRILLING LOG

HOLE NO.	SHEET	OF
WT114B	6	8 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
		POORLY GRADED SAND WITH GRAVEL (SP): SAME AS THE INTERVAL FROM 33.5'-35.0' EXCEPT MEDIUM DENSE. 35% GRAVEL.	BREATHING ZONE HNU = 4.8 UNITS O_2 = 20.7% LEL = 0%			13	N = 27 REC. = 0.2'
	44					14	
						13	
	45						
	46						
	47						
	48					23	N = 26 REC. = 0.7'
	49	POORLY GRADED SAND (SP): MEDIUM DENSE, WET, BROWN, MEDIUM TO COARSE SAND, TRACE OF GRAVEL. OUTWASH DEPOSITS.	BREATHING ZONE HNU = 5.0 UNITS O_2 = 20.7% LEL = 0%			20	
						6	
	50						
	51						
	52						

HTW DRILLING LOG

HOLE NO. WT114B

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

SHEET 7 OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	53						
	53.5	WELL GRADED SAND WITH GRAVEL (SW): MEDIUM DENSE, WET, BROWN, GRAVEL UP TO ¾" IN DIAMETER.	BREATHING ZONE HNU = 3.8 UNITS O_2 = 20.8% LEL = 0%			10	N = 21 REC. = 0.1'
	54					12	
	54.5					9	
	55						
	56						
	57						
	58						
	58.5	WELL GRADED SAND WITH GRAVEL (SW): SAME AS THE INTERVAL FROM 53.5'-55.0'.	BREATHING ZONE HNU = 3.8 UNITS O_2 = 20.8% LEL = 0%			15	N = 18 REC. = 0.5'
	59					9	
	59.5					9	
	60						
	61						
	62						

HTW DRILLING LOG

HOLE NO.	WT114B
PROJECT	HIMCO DUMP SUPERFUND SITE
INSPECTOR	MICHELLE BENAK
SHEET 8	OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	63						
	64	WELL GRADED GRAVEL WITH SAND (GW): MEDIUM DENSE, WET, BROWN TO GREY, 15%-20% MEDIUM TO COARSE SAND, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 4.8 UNITS O_2 = 20.8% LEL = 0%	D-1		5 7 12	N = 19 REC. = 1.5'
	65						
	66	BOTTOM OF HOLE @ 66.0'					
	67						

HTW DRILLING LOG

HOLE NO. WT115A

1. COMPANY NAME: U.S. ARMY CORPS OF ENGINEERS	2. DRILLING SUBCONTRACTOR: N/A
SHEET 1 OF 3 SHEETS	
3. PROJECT: HIMCO DUMP SUPERFUND SITE	4. LOCATION: ELKHART, IN.
5. NAME OF DRILLER: JOE MORRISSEY	6. MANUFACTURER'S DESIGNATION OF DRILL: GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4 1/4" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU P1101 PID; ISTMX 410 CGI.	8. HOLE LOCATION:
	9. SURFACE ELEVATION:
	10. DATE STARTED: 8-22-95 / 11. DATE COMPLETED: 8-22-95
12. OVERBURDEN THICKNESS: UNKNOWN	15. DEPTH GROUNDWATER ENCOUNTERED: 12.2'
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 18.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0		BACKGROUND HNU = 1.0 UNITS O_2 = 20.9% LEL = 0%				
	1						
	2						
	3						
		POORLY GRADED SAND (SP): LOOSE, MOIST, TAN, MEDIUM TO COARSE SAND, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 1.5 UNITS O_2 = 20.9% LEL = 0%			2	N = 9 REC. = 1.5'
	4					4	
	5					5	

HTW DRILLING LOG

HOLE NO. WT115A

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

SHEET 2 OF 3 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6						
	7						
	8						
	9	POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 3.5'-5.0' EXCEPT A LITTLE FINER GRAINED.	BREATHING ZONE HNU = 0.8 UNITS O_2 = 20.9% LEL = 0%			1 1 2	N = 3 REC. = 0.4'
	10						
	11						
	12						WATER @ 12.2'
	13						
	14	POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 3.5'-5.0' EXCEPT MEDIUM DENSE.	BREATHING ZONE HNU = 0.6 UNITS O_2 = 21.0% LEL = 0%	D-1		3 5	N = 10 REC. = 1.5'

HTW DRILLING LOG

HOLE NO.	SHEET	OF
WT115A	3	3 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
				D-1		5	
	15						
	16						
	17						
	18	BOTTOM OF HOLE @ 18.0'					
	19						

HTW DRILLING LOG

HOLE NO.	WT116A
SHEET 1 OF 3 SHEETS	

1. COMPANY NAME: U.S. ARMY CORPS OF ENGINEERS	2. DRILLING SUBCONTRACTOR: N/A
3. PROJECT: HIMCO DUMP SUPERFUND SITE	4. LOCATION: ELKHART, IN.
5. NAME OF DRILLER: JOE MORRISSEY	6. MANUFACTURER'S DESIGNATION OF DRILL: GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4 1/4" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT: HNU P1101PID: ISTMX 410 CGI.	8. HOLE LOCATION:
	9. SURFACE ELEVATION:
	10. DATE STARTED: 8-17-95 / 11. DATE COMPLETED: 8-17-95
12. OVERBURDEN THICKNESS: UNKNOWN	15. DEPTH GROUNDWATER ENCOUNTERED: 10.6'
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 8-18-95 7:40 AM 7.9'
14. TOTAL DEPTH OF HOLE: 15.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	SEE LOG OF BORING FOR WT116B FOR A DESCRIPTION OF MATERIALS DOWN TO 10' BELOW GROUND SURFACE.	BACKGROUND HNU = 0.2 UNITS O_2 = 20.9% LEL = 0%				AUGERED TO 13.5' AND OBTAINED A SAMPLE FROM 13.5'- 15.0'.
	1						
	2						
	3						
	4						
	5						

HTW DRILLING LOG

HOLE NO.
WT116A

PROJECT	INSPECTOR	SHEET
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	SHEET 2 OF 3 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6						
	7						
	8						
	9						
	10						
▽							WATER @ 10.6′
	11						
	12						
	13						
		POORLY GRADED SAND (SP): LOOSE. WET. GREY. 5% GRAVEL. OUTWASH DEPOSITS.				1	N = 4 REC. = 1.5′
	14		BREATHING ZONE O_2 = 20.9% LEL = 0%			1	

HTW DRILLING LOG

HOLE NO.
WT116A

PROJECT	INSPECTOR	SHEET 3
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	OF 3 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
						3	
	15	BOTTOM OF HOLE @ 15.0′					
	16						

HTW DRILLING LOG

HOLE NO.	WT116B
1. COMPANY NAME	U.S. ARMY CORPS OF ENGINEERS
2. DRILLING SUBCONTRACTOR	N/A
SHEET 1 OF 7 SHEETS	
3. PROJECT	HIMCO DUMP SUPERFUND SITE
4. LOCATION	ELKHART, IN.
5. NAME OF DRILLER	JOE MORRISSEY
6. MANUFACTURER'S DESIGNATION OF DRILL	GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	6 1/4" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU P1101 PID; 1STMX 410 CGI.
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-16-95
11. DATE COMPLETED	8-17-95
12. OVERBURDEN THICKNESS	UNKNOWN
15. DEPTH GROUNDWATER ENCOUNTERED	2.4' (CEMENT MAY HAVE TRAPPED WATER)
13. DEPTH DRILLED INTO ROCK	N/A
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	8-16-95 12:40 PM 9.5' 8-17-95 7:35 AM 7.6'
14. TOTAL DEPTH OF HOLE	60.0'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	8-18-95 9:00 AM 10.9'

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	TOPSOIL - VEGETATED, WEEDS.	BACKGROUND HNU = 2.6 UNITS O_2 = 20.8% LEL = 0%				
	1						
	2						
▽							WATER @ 2.4'
	3						
	4	CONSTRUCTION RUBBLE: RECOVERED PIECES OF CONCRETE, COVERED BY BLACK SUBSTANCE.	BREATHING ZONE HNU = 3.2 UNITS O_2 = 20.8% LEL = 0%			65 / 8 / 65	N = 73 REC. = 1.4'
	5						

HTW DRILLING LOG

PROJECT	INSPECTOR	HOLE NO.	SHEET
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	WT116B	SHEET 2 OF 7 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6						
	7						
	8	POORLY GRADED SAND (SP): LOOSE, MOIST, GREY, FINE TO MEDIUM SAND, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 0.4 UNITS O_2 = 20.8% LEL = 0%			1	N = 6 REC. = 1.4'
	9	ORGANIC SOIL (OL/OH): MEDIUM STIFF, MOIST, BLACK, SOME ROOTS.				3	
						3	
	10						
	11						
	12						
	13	POORLY GRADED SAND (SP): LOOSE, WET, GREY, MEDIUM SAND, 5% GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 1.0 UNITS O_2 = 20.9% LEL = 0%			1	N = 3 REC. = 1.5'
	14					2	

HTW DRILLING LOG

PROJECT	INSPECTOR	HOLE NO.
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	WT116B
		SHEET 3 OF 7 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	14.5–15					1	
	18.5	NO RECOVERY	BREATHING ZONE HNU = 1.2 UNITS O_2 = 20.9% LEL = 0%			1	N = 2 REC. = 0.0′
	19					1	
	19.5					1	
	23.5	POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 13.5′-15.0′ EXCEPT MEDIUM DENSE, MEDIUM TO COARSE SAND, 10% GRAVEL.	BREATHING ZONE HNU = 1.2 UNITS O_2 = 20.9% LEL = 0%			4	

Depth scale: 15, 16, 17, 18, 19, 20, 21, 22, 23, 24

HTW DRILLING LOG

PROJECT	INSPECTOR	HOLE NO. / SHEET
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	HOLE NO. WT116B; SHEET 4 OF 7 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
						8	N = 20 REC. = 1.5'
						12	
	25						
	26						
	27						
	28						
	29	POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 13.5'-15.0' EXCEPT MEDIUM DENSE, MEDIUM TO COARSE SAND.	BREATHING ZONE HNU = 1.4 UNITS O_2 = 20.9% LEL = 0%			9	N = 10 REC. = 1.4'
						7	
						3	
	30						
	31						
	32						
	33						END OF DRILLING 8-16-95

HTW DRILLING LOG

HOLE NO.	SHEET	OF
WT116B	5	7 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	33.5	POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 13.5'-15.0'.	BREATHING ZONE HNU = 1.6 UNITS O_2 = 20.8% LEL = 0%			1	BEGIN DRILLING ON 8-17-95
	34					2	N = 5 REC. = 1.5'
	34.5					3	
	35						
	36						
	37						
	38						
	38.5	POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 13.5'-15.0'.	BREATHING ZONE HNU = 0.8 UNITS O_2 = 20.8% LEL = 0%			1	N = 6 REC. = 1.5'
	39					3	
	39.5					3	
	40						
	41						
	42						
	43						

HTW DRILLING LOG

PROJECT	INSPECTOR	HOLE NO.	SHEET
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	WT116B	SHEET 6 OF 7 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	43.5	POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 13.5'-15.0' EXCEPT MEDIUM DENSE.	BREATHING ZONE HNU = 2.2 UNITS O_2 = 20.8% LEL = 0%			8	N = 15 REC. = 1.5'
	44					10	
	44.5					5	
	45						
	46						
	47						
	48						
	48.5	POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 13.5'-15.0'.	BREATHING ZONE HNU = 0.8 UNITS O_2 = 20.8% LEL = 0%			5	N = 9 REC. = 1.5'
	49					5	
	49.5					4	
	50						
	51						
	52						

HTW DRILLING LOG

HOLE NO.	SHEET
WT116B	7 OF 7 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	53						
		POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 13.5'-15.0' EXCEPT MEDIUM TO COARSE SAND.	BREATHING ZONE HNU = 2.0 UNITS O_2 = 20.8% LEL = 0%			2	N = 7 REC. = 1.5'
	54	POORLY GRADED SAND (SP): LOOSE, WET, BROWN, FINE SAND, OUTWASH DEPOSITS.				2	
						5	
	55						
	56						
	57						
	58	POORLY GRADED SAND (SP): LOOSE, WET, GREY, 10% GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 1.0 UNITS O_2 = 20.9% LEL = 0%	D-1		3	N = 6 REC. = 1.5'
	59					3	
						3	
	60	BOTTOM OF HOLE @ 60.0'					
	61						
	62						

HTW DRILLING LOG

HOLE NO.	WT117A
SHEET 1 OF 3 SHEETS	
1. COMPANY NAME	U.S. ARMY CORPS OF ENGINEERS
2. DRILLING SUBCONTRACTOR	N/A
3. PROJECT	HIMCO DUMP SUPERFUND SITE
4. LOCATION	ELKHART, IN.
5. NAME OF DRILLER	JOE MORRISSEY
6. MANUFACTURER'S DESIGNATION OF DRILL	GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4 1/4" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU P1101 PID; 1STMX 410 CGI.
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-15-95
11. DATE COMPLETED	8-15-95
12. OVERBURDEN THICKNESS	UNKNOWN
13. DEPTH DRILLED INTO ROCK	N/A
14. TOTAL DEPTH OF HOLE	17.5'
15. DEPTH GROUNDWATER ENCOUNTERED	SEE LOG OF WT117B
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	8-18-95 11:00AM 11.3'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	SEE LOG OF BORING FOR WT117B FOR A DESCRIPTION OF MATERIALS DOWN TO 10' BELOW GROUND SURFACE.	BACKGROUND HNU = 1.2 UNITS O_2 = 20.9% LEL = 0%				AUGERED TO 13.5' AND OBTAINED A SAMPLE FROM 13.5'- 15.0'.
	1		BREATHING ZONE HNU = 1.2 UNITS O_2 = 20.8% LEL = 0%				
	2						
	3						
	4						
	5						

PROJECT	HOLE NO.
HIMCO DUMP SUPERFUND SITE	WT117A

D-45

HTW DRILLING LOG

HOLE NO.	SHEET	PROJECT	INSPECTOR
WT117A	2 OF 3 SHEETS	HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
		WELL GRADED SAND (SW): MEDIUM DENSE, WET, BROWN, FINE TO MEDIUM SAND, OUTWASH DEPOSITS.				4	N = 10 REC. = 1.2'
	14					6	WATER ADDED TO HOLE TO RETRIEVE SAMPLE.

HTW DRILLING LOG

HOLE NO.
WT117A

PROJECT	INSPECTOR	SHEET 3 OF 3 SHEETS
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
						4	
	15						
	16						
	17						
		BOTTOM OF HOLE @ 17.5'					
	18						

HTW DRILLING LOG

HOLE NO.	WT117B
1. COMPANY NAME	U.S. ARMY CORPS OF ENGINEERS
2. DRILLING SUBCONTRACTOR	N/A
SHEET 1 OF 8 SHEETS	
3. PROJECT	HIMCO DUMP SUPERFUND SITE
4. LOCATION	ELKHART, IN.
5. NAME OF DRILLER	JOE MORRISSEY
6. MANUFACTURER'S DESIGNATION OF DRILL	GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	6 1/4" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU P1101 PID; ISTMX 410 CGI.
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-14-95
11. DATE COMPLETED	8-14-95
12. OVERBURDEN THICKNESS	UNKNOWN
13. DEPTH DRILLED INTO ROCK	N/A
14. TOTAL DEPTH OF HOLE	65.0'
15. DEPTH GROUNDWATER ENCOUNTERED	11.5'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	8-15-95 7:51AM 11.0' 8-18-95 11:54AM 10.3'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0		BACKGROUND HNU = 3.2 UNITS O_2 = 20.9% LEL = 0%				
	1						
	2						
	3	POORLY GRADED SAND (SP): LOOSE, MOIST, LIGHT BROWN, FINE TO COARSE SAND, OUTWASH DEPOSITS.				2	N = 6 REC. = 1.5'
	4					3	
	5					3	

HTW DRILLING LOG

HOLE NO.	WT117B
PROJECT	HIMCO DUMP SUPERFUND SITE
INSPECTOR	MICHELLE BENAK
SHEET	2 OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6						
	7						
	8						
		WELL GRADED SAND (SW): LOOSE, MOIST, LIGHT BROWN, MEDIUM TO COARSE SAND, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 3.0 UNITS O_2 = 20.9% LEL = 0%			3	N = 8 REC. = 1.4'
	9					4	
						4	
	10						
	11						
▽							WATER MEASURED @ 11.5'
	12						
	13						
		WELL GRADED SAND (SW): SAME AS THE INTERVAL FROM 8.5'-10.0' EXCEPT MEDIUM DENSE, WET, COARSER GRAINED, 5% GRAVEL.	BREATHING ZONE HNU = 2.5 UNITS O_2 = 20.9% LEL = 0%			1	N = 12 REC. = 1.5'
	14					4	

HTW DRILLING LOG

HOLE NO. WT117B

PROJECT	INSPECTOR	SHEET 3 OF 8 SHEETS
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
						8	
	15						
	16						
	17						
	18						
		WELL GRADED SAND (SW): SAME AS THE INTERVAL FROM 8.5'-10.0' EXCEPT WET.	BREATHING ZONE HNU = 2.0 UNITS O_2 = 20.9% LEL = 0%			3	N = 14 REC. = 1.5'
	19					6	
		POORLY GRADED SAND (SP): MEDIUM DENSE, WET, LIGHT GREY, FINE TO MEDIUM SAND, OUTWASH DEPOSITS.				8	
	20						
	21						
	22						
	23						
		WELL GRADED SAND WITH GRAVEL (SW): LOOSE, WET, GREY, FINE TO COARSE SAND, 15%-20% GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 2.0 UNITS O_2 = 20.9% LEL = 0%			2	
	24						

HTW DRILLING LOG

HOLE NO.	SHEET	OF
WT117B	4	8 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
						2	N = 8 REC. = 0.8'
						6	
	25						
	26						
	27						
	28						
		WELL GRADED SAND WITH GRAVEL (SW): SAME AS THE INTERVAL FROM 23.5'-25.0'.	BREATHING ZONE HNU = 1.8 UNITS O_2 = 20.9% LEL = 0%			3	N = 18 REC. = 1.4'
	29	WELL GRADED GRAVEL (GW): WET, GREY, COARSE GRAVEL, OUTWASH DEPOSITS.				4	
		WELL GRADED SAND WITH GRAVEL (SW): SAME AS THE INTERVAL FROM 23.5'-25.0'.				14	
	30						
	31						
	32						
	33						

HTW DRILLING LOG

HOLE NO.	SHEET	OF
WT117B	5	8 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
		WELL GRADED SAND (SW): MEDIUM DENSE, WET, GREY, FINE TO COARSE SAND, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 1.6 UNITS O_2 = 20.9% LEL = 0%			3	N = 14 REC. = 1.5'
	34					6	
						8	
	35						
	36						
	37						
	38						
						4	N = 37 REC. = 1.5'
	39	WELL GRADED SAND (SW): SAME AS THE INTERVAL FROM 33.5'-35.0' EXCEPT DENSE, 5% GRAVEL.	BREATHING ZONE HNU = 1.8 UNITS O_2 = 20.9% LEL = 0%			10	
						27	
	40						
	41						
	42	- - - - - - - - - -					
	43						

HTW DRILLING LOG

HOLE NO. WT117B

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

SHEET 6 OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	44	WELL GRADED GRAVEL (GW): LOOSE, WET, GREY, FINE TO COARSE GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 1.6 UNITS O_2 = 20.9% LEL = 0%			5 4 4	N = 8 REC. = 1.2'
	45						
	46						
	47						
	48						
	49	WELL GRADED GRAVEL (GW): SAME AS THE INTERVAL FROM 43.5'-45.0' EXCEPT MEDIUM DENSE.	BREATHING ZONE HNU = 1.5 UNITS O_2 = 20.9% LEL = 0%			10 5 7	N = 12 REC. = 1.1'
	50						
	51						
	52						

HTW DRILLING LOG

HOLE NO.	SHEET	OF
WT117B	7	8 SHEETS

PROJECT	INSPECTOR
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	53						
		POORLY GRADED SAND WITH GRAVEL (SP): DENSE, WET, GREY, FINE TO COARSE SAND, 15%-20% GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 1.6 UNITS O_2 = 20.9% LEL = 0%			19	N = 34 REC. = 0.6′
	54					22	
						12	
	55						
	56						
	57	- - - - - - - - - -					
	58						
		WELL GRADED GRAVEL (GW): LOOSE, WET, GREY, FINE TO COARSE GRAVEL. OUTWASH DEPOSITS.	BREATHING ZONE HNU = 1.6 UNITS O_2 = 20.9% LEL = 0%			4	N = 7 REC. = 0.9′
	59					4	
						3	
	60						
	61						
	62						

HTW DRILLING LOG

HOLE NO.	SHEET
WT117B	8 OF 8 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	63						
	63.5–65	WELL GRADED GRAVEL (GW): SAME AS THE INTERVAL FROM 58.5'-60.0'.	BREATHING ZONE HNU = 0.5 UNITS O_2 = 20.9% LEL = 0%			1 / 4 / 3	N = 7 REC. = 1.5'
	65	BOTTOM OF HOLE @ 65.0'					THE MONITORING WELL SET IN THIS BORING WAS ABANDONED DUE TO NON-COMPLIANCE WITH THE FIELD SAMPLING PLAN. A NEW BORING LOCATED 10.0' SOUTH OF THE ORIGINAL BORING WAS AUGERED DOWN TO 62.5' BELOW GROUND SURFACE AND A NEW MONITORING WELL WAS INSTALLED.
	66						
	67						

HTW DRILLING LOG

HOLE NO.	WT118B
1. COMPANY NAME	U.S. ARMY CORPS OF ENGINEERS
2. DRILLING SUBCONTRACTOR	N/A
SHEET	1 OF 8 SHEETS
3. PROJECT	HIMCO DUMP SUPERFUND SITE
4. LOCATION	ELKHART, IN.
5. NAME OF DRILLER	JOE MORRISSEY
6. MANUFACTURER'S DESIGNATION OF DRILL	GUS PECH 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	6¼" I.D. HSA; 2" O.D. CARBON STEEL SPLIT SPOON SAMPLER DRIVEN BY A 140 POUND HAMMER FOR SPT; HNU P1101 PID; 1STMX 410 CGI.
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-18-95
11. DATE COMPLETED	8-18-95
12. OVERBURDEN THICKNESS	UNKNOWN
15. DEPTH GROUNDWATER ENCOUNTERED	12.0'
13. DEPTH DRILLED INTO ROCK	N/A
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	8-21-95 9:24AM 11.0'
14. TOTAL DEPTH OF HOLE	63.5'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		2" PVC		MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	TOPSOIL - WEEDS	BACKGROUND HNU = 0.2 UNITS O_2 = 20.8% LEL = 0%				
	1						
	2						
	3						
		POORLY GRADED SAND WITH SILT (SP-SM): MOIST, BROWN, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 0.0 UNITS O_2 = 20.9% LEL = 0%				
	4	POORLY GRADED SAND (SP): LOOSE, MOIST, LIGHT BROWN, MEDIUM TO COARSE SAND, OUTWASH DEPOSITS.				2	N = 5 REC. = 1.5'
						2	
	5					3	

HTW DRILLING LOG

HOLE NO.	SHEET	PROJECT	INSPECTOR
WT118B	2 OF 8 SHEETS	HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6						
	7						
	8						
		POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 3.7'-5.0' EXCEPT TAN.	BREATHING ZONE HNU = 0.0 UNITS O_2 = 21.0% LEL = 0%			2	N = 5 REC. = 1.5'
	9	POORLY GRADED SAND (SP): LOOSE, MOIST, TAN, FINE SAND, OUTWASH DEPOSITS.				2	
						3	
	10						
	11						
▽	12						WATER MEASURED @ 12.0'
	13						
		POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 9.1'-10.0' EXCEPT WET.	BREATHING ZONE HNU = 0.2 UNITS O_2 = 20.9% LEL = 0%				N = 1 (ONE 6" INTERVAL ONLY) REC. = 1.5'
	14						

HTW DRILLING LOG

HOLE NO.	SHEET	
WT118B	3	OF 8 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE
INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
						1	
	15						
	16						
	17						
	18						
		POORLY GRADED SAND (SP): SAME AS THE INTERVAL FROM 9.1'-10.0' EXCEPT WET.	BREATHING ZONE HNU = 0.1 UNITS O_2 = 20.9% LEL = 0%				N = 1 (ONE 6" INTERVAL ONLY) REC. = 1.5'
	19	POORLY GRADED SAND WITH GRAVEL (SP): WET, GREY, MEDIUM TO COARSE SAND, 20%-25% GRAVEL, OUTWASH DEPOSITS.					
						1	
	20						
	21						
	22						
	23						
		POORLY GRADED SAND WITH GRAVEL (SP): SAME AS THE INTERVAL FROM 19.1'-20.0' EXCEPT LOOSE.	BREATHING ZONE HNU = 0.1 UNITS O_2 = 20.9% LEL = 0%			1	
	24						

HTW DRILLING LOG

HOLE NO.	SHEET	PROJECT	INSPECTOR
WT118B	5 OF 8 SHEETS	HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	34	WELL GRADED GRAVEL (GW): SAME AS THE INTERVAL FROM 28.5'-30.0' EXCEPT LOOSE.	BREATHING ZONE HNU = 0.0 UNITS O_2 = 21.0% LEL = 0%			4 5 4	N = 9 REC. = 1.3'
	35						
	36						
	37						
	38						
	39	WELL GRADED GRAVEL (GW): SAME AS THE INTERVAL FROM 28.5'-30.0'.	BREATHING ZONE HNU = 0.2 UNITS O_2 = 20.9% LEL = 0%			6 8 7	N = 15 REC. = 1.5'
	40						
	41						
	42						
	43						

HTW DRILLING LOG

HOLE NO.	SHEET
WT118B	6 OF 8 SHEETS

PROJECT: HIMCO DUMP SUPERFUND SITE

INSPECTOR: MICHELLE BENAK

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
		WELL GRADED GRAVEL (GW): SAME AS THE INTERVAL FROM 28.5'-30.0' EXCEPT DENSE.	BREATHING ZONE HNU = 0.2 UNITS O_2 = 20.9% LEL = 0%			10	N = 42 REC. = 1.1'
	44					17	
						25	
	45						
	46						
	47						
	48					6	N = 15 REC. = 1.0'
	49	WELL GRADED GRAVEL (GW): SAME AS THE INTERVAL FROM 28.5'-30.0'.	BREATHING ZONE HNU = 0.2 UNITS O_2 = 21.0% LEL = 0%			8	
						7	
	50						
	51						
	52						

HTW DRILLING LOG

HOLE NO.
WT118B

PROJECT	INSPECTOR	SHEET 7
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	OF 8 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	53						
		POORLY GRADED SAND WITH GRAVEL (SP): MEDIUM DENSE, WET, GREY, MEDIUM TO COARSE SAND, 25%-30% GRAVEL, OUTWASH DEPOSITS.	BREATHING ZONE HNU = 0.2 UNITS O_2 = 20.9% LEL = 0%			7	N = 22 REC. = 1.2'
	54					9	
						13	
	55						
	56						
	57						
	58						
		POORLY GRADED SAND WITH GRAVEL (SP): SAME AS THE INTERVAL FROM 53.5'-55.0'.	BREATHING ZONE HNU = 0.2 UNITS O_2 = 21.0% LEL = 0%	D-1		13	N = 22 REC. = 1.3'
	59					10	
						12	
	60						
	61						
	62						

HTW DRILLING LOG

HOLE NO.
WT118B

PROJECT	INSPECTOR	SHEET 8 OF 8 SHEETS
HIMCO DUMP SUPERFUND SITE	MICHELLE BENAK	

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	63						
		BOTTOM OF HOLE @ 63.5'					
	64						
	65						

HTW DRILLING LOG

1. COMPANY NAME: USACE	2. DRILLING SUBCONTRACTOR:	HOLE NO. B-3; SHEET 1 OF 2 SHEETS
3. PROJECT: Himco Superfund Site	4. LOCATION: Elkhart, IN	
5. NAME OF DRILLER: Joe Morrissey	6. MANUFACTURER'S DESIGNATION OF DRILL: Gus Pech 1100C	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Gus Pech 1100C Rig; 4 1/4" HSA with 3.50" dia.; 5.0' Continuos sampler; HNU PI 101 PID; ISTMX 410 CGI	8. HOLE LOCATION:	
	9. SURFACE ELEVATION:	
	10. DATE STARTED: 8-29-95	11. DATE COMPLETED: 8-29-95
12. OVERBURDEN THICKNESS: 8.0'	15. DEPTH GROUNDWATER ENCOUNTERED: No water encountered	
13. DEPTH DRILLED INTO ROCK: Ø	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:	
14. TOTAL DEPTH OF HOLE: 8.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	w/cuttings			Michelle Benak

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	Topsoil silt with sand (ML), dry, dense, roots Evidence of plastic bag	Background HNU .5 units				Scattered trash in the area - plastic bags, rusted out drum 25' east, bird cages, more east a pit with burnt trash in it close to hole WT118B
	1	Poorly graded sand (SP) slightly moist, fine grained, med. dense	O_2 20.9% LEL 0%				
		Sand becoming a little coarser					
	2	Poorly graded sand (SP) Same as above color becoming more orange and rust color	BZ HNU .6 units O_2 20.8% LEL 0%				Rec. = 5.0'
	3						
	4						
	5						

PROJECT | D-63 | HOLE NO. B-3

HTW DRILLING LOG

HOLE NO. B-3

PROJECT Himco Superfund Site | INSPECTOR Michelle Benak | SHEET 2 OF 2 SHEETS

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
		Poorly graded sand (SP) 5-10% gravel, med. dense, moist rust to light brown in color	BZ HNU- .8 units O_2- 20.9% LEL- 0%				Rec. 3.0' *No other trash was found throughout the boring
	6						
	7						
	8						B.O.H. 8.0'
	9						
	10						
	11						
	12						
	13						
	14						

HTW DRILLING LOG

HOLE NO. B-7

1. COMPANY NAME: USACE	2. DRILLING SUBCONTRACTOR:	SHEET 1 OF 2 SHEETS
3. PROJECT: Himco Superfund Site	4. LOCATION: Elkhart, IN	
5. NAME OF DRILLER: Joe Morrissey	6. MANUFACTURER'S DESIGNATION OF DRILL: Gus Pech 1100 C	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Gus Pech 1100C Rig; 4 1/4 HSA; HNU PI 101 PID; ISTMX 410 CGI	8. HOLE LOCATION:	
	9. SURFACE ELEVATION:	
	10. DATE STARTED: 8-28-95	11. DATE COMPLETED: 8-28-95
12. OVERBURDEN THICKNESS: 8'	15. DEPTH GROUNDWATER ENCOUNTERED: No water	
13. DEPTH DRILLED INTO ROCK: Ø	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:	
14. TOTAL DEPTH OF HOLE: 8'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	with cuttings			Michelle Benak

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	Poorly graded sand w/ silt (SP/SM) brown, dry, roots	Background HNU .6 units				weather: Cloudy, 80°
		Poorly graded sand (SP) moist, med. grained, med. dense, orange to brown color	O_2 20.9%				Top vegetation long grasses, weeds
	1		LEL 0%				
	2		BZ HNU .3 units				
	3		O_2 20.9%				
			LEL 0%				
	4						
	5						

HTW DRILLING LOG

HOLE NO. B-7

PROJECT Himco Superfund Site

INSPECTOR Michelle Berak

SHEET 2 OF 2 SHEETS

DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
6						
7						
8						B.O.H 8.0'
9						
10						
11						
12						
13						
14						

PROJECT D-66 HOLE NO. B-7

HTW DRILLING LOG

HOLE NO.	B-9
1. COMPANY NAME	USACE
2. DRILLING SUBCONTRACTOR	
SHEET	1 OF 2 SHEETS
3. PROJECT	Himco Superfund Site
4. LOCATION	Elkhart, IN
5. NAME OF DRILLER	Joe Morrissey
6. MANUFACTURER'S DESIGNATION OF DRILL	Gus Pech 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	Gus Peck 1100C Rig 4 1/4" HSA with 3.5" 5' long continuous Sampler HNU PI 101 PID ISTMX 410 CGI
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-28-95
11. DATE COMPLETED	8-28-95
12. OVERBURDEN THICKNESS	10'
13. DEPTH DRILLED INTO ROCK	0
14. TOTAL DEPTH OF HOLE	10'
15. DEPTH GROUNDWATER ENCOUNTERED	6.1'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	4		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
				Michelle Benak

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	Top soil - roots mostly	Background				Top of ground vegetated with weeds
		well graded sand (SW) dry 15-20% gravel, med. grained, med. dense, tan color	HNU .8 units O_2 - 20.8% LEL - 0%	D-1			
	1						Rec. 3.6
	2						
		Poorly graded sand (SP) moist, black, med. dense med. grained sand	BZ HNU - .6 units O_2 - 20.8% LEL - 0%	D-2			
	3						
	4						
	5			D-67			

PROJECT: Himco Superfund Site

HOLE NO. B-9

HTW DRILLING LOG

HOLE NO. B-9

PROJECT Himco Superfund Site

INSPECTOR Michelle Benak

SHEET 2 OF 2 SHEETS

DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
.	well graded sand (SW) 5% gravel, wet, tan, med. dense	BZ HNU .6 units O2 20.8% LEL- 0%	D-3			
6						Water at 6.1'
						Rec. 2.5'
7	Poorly graded sand (SP) wet, brown med to fine grained med. dense		D-4			
8						
9						
10						B.O.H. 10.0'
11						
12						
13						
14						

D-68

HTW DRILLING LOG

HOLE NO. B-10

1. COMPANY NAME: USACE	2. DRILLING SUBCONTRACTOR:
SHEET 1 OF 2 SHEETS	
3. PROJECT: Himco Superfund Site	4. LOCATION: Elkhart, IN
5. NAME OF DRILLER: Joe Morrissey	6. MANUFACTURER'S DESIGNATION OF DRILL: Gus Pech 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Gus Pech 1100C Rig; 4 1/4" HSA 3.5" continuous sampler 5.0' long; HNU PI 101 PID; IS TMX 410 CGI	8. HOLE LOCATION:
	9. SURFACE ELEVATION:
	10. DATE STARTED: 8-29-95
	11. DATE COMPLETED: 8-29-95
12. OVERBURDEN THICKNESS: 10'	15. DEPTH GROUNDWATER ENCOUNTERED: 7.6' 9:15 am
13. DEPTH DRILLED INTO ROCK: Ø	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 10'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	3 (bags)		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	w/cuttings			Michelle Benak

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	Top soil silt with sand (ML) brown, dry, <5% fine grained sand, roots present	Background HNU 1.1 units	D-1			weather pt. cloudy and warm 80°
	1		O_2 20.9%				Rec. = 5.0'
		Poorly graded sand (SP) moist, med coarse, orange to light brown, med. dense	LEL 0%				
	2			D-2			
	3		BZ HNU .8 units O_2 20.8% LEL 0%				
	4						
	5			D-69			

PROJECT: Himco Superfund Site | HOLE NO. B-10

HTW DRILLING LOG

PROJECT	INSPECTOR	HOLE NO.	SHEET
Himco Superfund Site	Michelle Benak	B-10	SHEET 2 OF 2 SHEETS

DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	Poorly graded sand (SP) wet, med. dense, a little bit coarser grained than above material	BZ HNU .6 units O_2 20.9% LEL 0%	D-3			Rec. ~~[illegible]~~ M.B. = 1.5'
6						
7						9:15am Water 7.6'
8						
9						
10						10.0' B.O.H.
11						
12						
13						
14			D-70			

HTW DRILLING LOG

HOLE NO.	B-11
1. COMPANY NAME	USACE
2. DRILLING SUBCONTRACTOR	
SHEET	1 OF 2 SHEETS
3. PROJECT	Himco Superfund Site
4. LOCATION	Elkhart IN
5. NAME OF DRILLER	Joe Morrissey
6. MANUFACTURER'S DESIGNATION OF DRILL	Gus Pech 1100C
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	Gus Pech 1100C Rig 4 1/4" HSA with ~~3.5'~~ 5.0' long continuous sampler HNU PI 101 PID IS TMX 410CGI
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	8-29-95
11. DATE COMPLETED	8-29-95
12. OVERBURDEN THICKNESS	10.0'
15. DEPTH GROUNDWATER ENCOUNTERED	Water at 8.4' 8:00 am
13. DEPTH DRILLED INTO ROCK	Ø
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE	10.0'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	2 (Bags)		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	w/cuttings			Michelle Benak

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	Top soil weeds, roots sand (SP) some fines	Background HNU 1.5 units				
		Poorly graded sand (SP) moist, orange, mod. grained, mod. dense					
	1		O_2 20.8% LEL 0%				Rec. 4.8'
	2		BZ HNU 1.5 units	D-1			
	3		O_2 20.7% LEL 0%				
	4						
	5			D-71			

PROJECT	HOLE NO.
Himco Superfund Site	B-11

HTW DRILLING LOG

HOLE NO.	SHEET	PROJECT	INSPECTOR
B-11	2 of 2 SHEETS	Himco Superfund Site	Michelle Benak

ELEV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	6	Poorly graded Sand (SP) (same as above) color a little bit lighter and grain size a little bit coarser	BZ HNU 9 units O2 20.8% LEL 0%	D-2			Rec. 3.0'
	7						
	8						8:00am water at 8.4'
	9						
	10						10.0' B.O.H.
	11						
	12						
	13						
	14						

D-72

PROJECT Himco Superfund Site HOLE NO. B-11

APPENDIX E

REMEDIAL ACTION
HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX E
RI/FS TRENCH LOGS

HIMCO DUMP SUPERFUND SITE
TRENCH LOG SUMMARY TABLE

Trench No.	Debris Depth	Debris Type	Notes
TP-1	6-12	Const/Sludge	Misc. Construction Type Debris Mixed with Sand, Possible Sludge
TP-2	4-10	Constr.	Construction Debris mixed with sand
TP-3	8	Constr.	Construction Debris mixed with sand
TP-4	8	Const/Sludge	Construction Debris mixed with sand, some sludge
TP-5&6	2-10	CaSO4/Const	CaSO4 from 2-10 ft. thick, Misc. Constr. Debris
TP-7&8	12+	Constr/Munic	Predominantly Construction Debris w/ Some Municipal
TP-9	12+	CaSO4/Const	CaSO4 from 2 to 3 ft. thick, Misc. Const. Debris
TP-10&11	8	CaSO4/Munic	Predominantly CaSO4 with small amount of municipal
TP-12&13	10	CaSO4/Const	Predominantly CaSO4 overlying thin layer construction
TP-14&15	3+	CaSO4/Sludge	Thin layer CaSO4 (1 ft.) over possible sludge layers
TP-16	4+	Constr/Munic	Predominantly Construction Debris W/ some municipal
TP-17	2+	CaSO4/Constr	Thin layer CaSO4 (1ft) over construction debris
TP-18	7+	CaSO4/Munic	Thin layer CaSO4 (1 ft) over municipal & construction debris
TP-19	9+	CaSO4/Munic	Thin layer CaSO4 (1 ft) over municipal debris
TP-20	12+	CaSO4/Munic	Thin layer CaSO4 (1 ft) over municipal debris
TD-1	9+	CaSO4/Mixed	Thin layer CaSO4 (1 ft) over municipal & construction debris
TD-2	4+	Constr/Munic	Predominantly Construction Debris w/ Some Municipal
TD-3	14+	CaSO4/Munic	Thin layer CaSO4 (1 ft) over mix of municipal and sludges
TD-4	11	Constr.	Construction Debris mixed with sand
TD-5	9	Constr.	Construction debris with some sand
TD-6	4+	Constr.	Construction debris

TL-1	8+	CaSO4/Mixed	Thin layer CaSO4 (1 ft.) with municipal and some construction
TL-2	6+	CaSO4/Mixed	Thin layer CaSO4 (1 ft.) with municipal and some construction
TL-3	11	Const/Sludge	Construction Debris mixed with sand, some possible sludge
TL-4	5+	Constr.	Construction debris mixed with sand
TL-5	12	Const/Sludge	Construction Debris mixed with sand, some possible sludge
TL-6	4	Const	Construction debris mixed with sand
TL-7	7+	Sand	Fill sand

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: HIMCO
PROJECT NO.: 20026.023
DATE: 11/29/90
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: MATHES
LOG BY: TEP
TRENCH NO.: TP-1
TRENCH LENGTH: 0 FT TO 25 FT
TRENCH WIDTH: ~~5 ft to 10 ft where caved~~

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1 2 3 4 5 6 7 8 9 0	DRUM QUANTITY	REMARK NO.
		Brn silty sand top soil 10 yr 5/6 ylwish brn		
		White silt grading to blk at base		
		~~Black debris, saturated, bricks, wood, metal scraps, wire, railroad ties, trace Alka seltzer~~ bottles		
	5	Plastic bag layer ends here		
		Mauve material paste-like Water flows down to trench from here south		
		Bottom		
	10			
	15			
	20			
	25			

REMARKS:

E-4

E-5

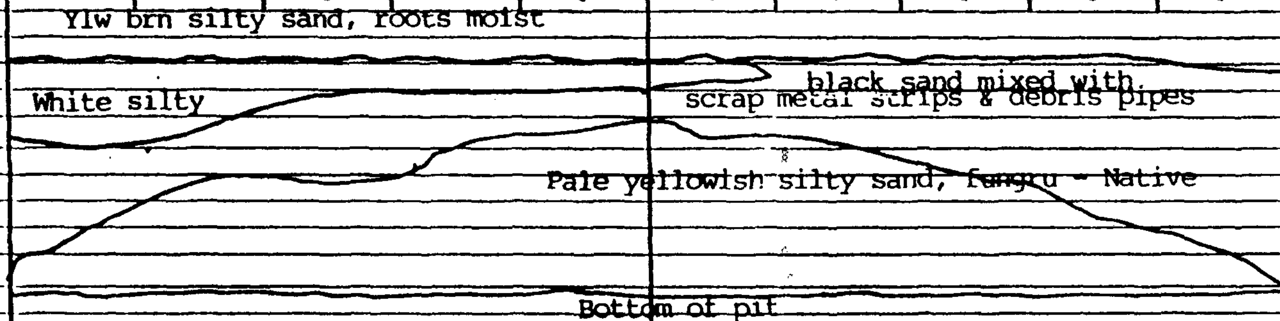
TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: HIMCO
PROJECT NO.: 20026.023
DATE: 11/29/90
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: MATHES
LOG BY: TEP
TRENCH NO.: TP-2
TRENCH LENGTH: 25 FT TO 50 FT
TRENCH WIDTH: 5 ft

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1 2 3 4 5 6 7 8 9 0	DRUM QUANTITY	REMARK NO.
	5			
	10			
	15			
	20			
	25			



REMARKS:

E-6

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: HIMCO
PROJECT NO.: 20026.023
DATE: 11/28/90
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: MATHES
LOG BY: TEP
TRENCH NO.: TP-3
TRENCH LENGTH: 50 FT TO 75 FT
TRENCH WIDTH: 5-8 ft

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1 2 3 4 5 6 7 8 9 0	DRUM QUANTITY	REMARK NO.
		Ylw brn 10 yr 5/6 silty sand top soil moist, roots		
		Brown & white silt layer		
	5	Black sand metal strips & sscraps - metal corroded, 2 drum Lids, buff sand at base		
	10	25Y 7/4 Pale ylw fr green silty sand - Native soil		
	15			
	20			
	25			

REMARKS:

E-7

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: HIMCO
PROJECT NO.: 20026.023
DATE: 11/28/90
GRID COORD.: START - N___ E___ N___ E___
END - N___ E___ N___ E___
CONTROL MONUMENT GRID COORD.: N___ E___ N___ E___
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: MATHES
LOG BY: TEP
TRENCH NO.: TP-4
TRENCH LENGTH: 75 FT TO 100 FT
TRENCH WIDTH: 8 ft.

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT)	DRUM QUANTITY	REMARK NO.
	1			
	2	Black and white stringers (solidified sludge) yp to 2' most 6" in brown sand		
		Anacin boxes - empty		
	5	Thin metal strips "1" wide metal pipe pinches out on north		
		scarce - 3 or 4 corroded drum lids, scrap metal pipe, sheet metal		
		Tanto grey silty san (sm) Native		
	10			
		BOTTOM		
	15			
	20			
	25			

REMARKS:

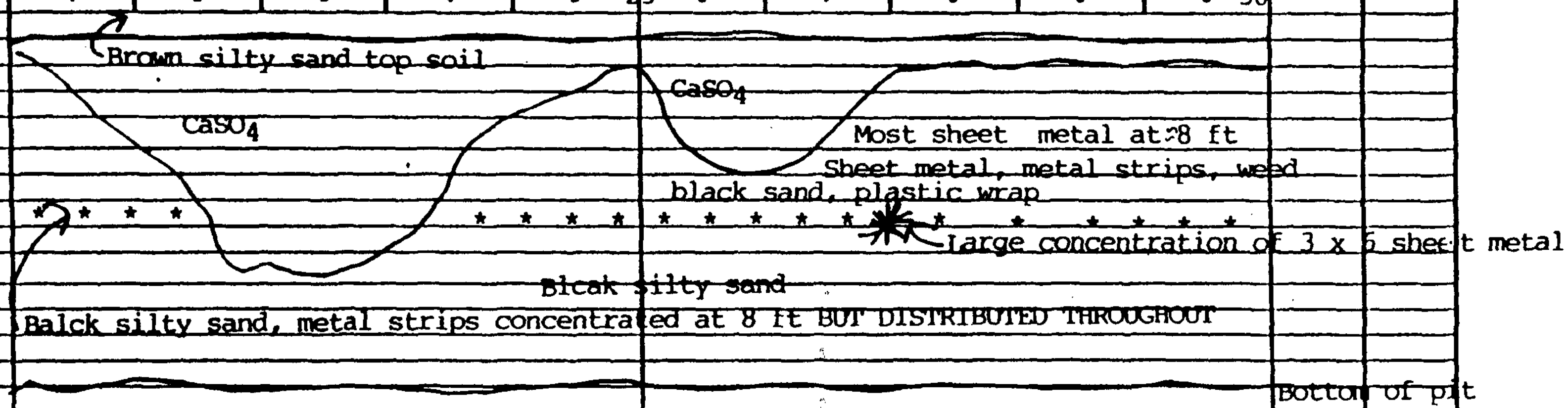
TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: HIMCO
PROJECT NO.: 20026.023
DATE: 11/28/90
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH: TP-5 TP-6

SHEET 1 OF 1
EXCAVATOR: MATHES
LOG BY: TEP
TRENCH NO.: TP 5 & 6
TRENCH LENGTH: 75 FT TO 100 FT
TRENCH WIDTH: 5 feet

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 25 50	DRUM QUANTITY	REMARK NO.
	5			
	10			
	15			
	20			
	25			



REMARKS:

TP-5 & 6

TRENCH LOG FORM

Donohue

CLIENT: USEPA-ARCS
PROJECT: HIMCO
PROJECT NO.: 20026.023
DATE: 11/29/90
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH: N

SHEET 1 OF 1
EXCAVATOR: MATHES CHRIS GOODWIN MIKE DONAHUE
LOG BY: TEP
TRENCH NO.: 7 & 8
TRENCH LENGTH: 0 FT TO 50 FT
TRENCH WIDTH: 5 ft.

TP-7 TP-8 S

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1–5	TRENCH LENGTH (FT) 6–0	DRUM QUANTITY	REMARK NO.
		CaSO4			
		Thin layer of topsoil	Metal Pipe		
			Car BUMPER, REFRIGERATOR COMPRESSOR		
	5		SHEET METAL		
		MIXED WASTE - FIBERGLASS TEMPLATES, WOOD, PAPER, AEROSOL CANS-SUDDEN BEAUTY HAIR SPRAY, CRISTAN		HALY FEVER SPRAY	
		TOOTHPASTE SAMPLER, Alka-Seltzer wrappers, plastic bags	metal pipe		
			DRUM - 25-gallon - CORRODED		
	10	black sand, alka seltzer lids	Matrix of mixed waste; NATIVE YELLOW BRN SAND		
		BOTTOM OF PIT	BOTTOM OF PIT		
	15				
		DRUM:			
		1 55-gallon • unmarked	3 lids; 1 marked Aliphatic Resin		
	20	1 25-gallon + unmarked			
	25				

REMARKS:

E-9

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: HIMCO DUMP
PROJECT NO.: 20026.023
DATE: 11/29/90
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: MATHES
LOG BY: TOM PUCHALSKI
TRENCH NO.: TP-9
TRENCH LENGTH: 0 FT TO 25 FT
TRENCH WIDTH: 5-6 ft

TP-9

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT)	DRUM QUANTITY	REMARK NO.
		$CaSO_4$		
		3 drum lids		
	5	Tires, wood, black sand, plastic bags, Alka-seltzer wrappers		
		rubber in 1/8" bands		
		$CaSO_4$		
	10	Paper, plastic bags		
		bottom at 12'		
	15			
	20			
	25			

REMARKS: The only metal present was three 55 gallon drum lids - unmarked, and budndles of wire all at about 4' depth.

E-10

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: HIMCO
PROJECT NO.: 20026.023
DATE: 11/30/90
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: MATHES
LOG BY: TOM PUCHALSKI
TRENCH NO.: 10 & 11
TRENCH LENGTH: 0 FT TO 50 FT
TRENCH WIDTH: 5 ft.

N — 10 — 11 — S

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT)	DRUM QUANTITY	REMARK NO.
		Ylw Brw silty sand TOP SOIL - roots		
		Plastic bags, bottles, wood paper		
	5	$CaSO_4$ - Black layer mixed with white & gray, some 1" x 5" boards.		
		Bottom of pit		
	10			
	15			
	20			
	25			

REMARKS: Very little metal. One piece of sheet metal was located 10 feet south of north edge of TP-10 at 3" depth.

E-11

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: HIMCO
PROJECT NO.: 20026.023
DATE: 11/30/90
GRID COORD.: START - N____ E____ N____ E____
END - N____ E____ N____ E____
CONTROL MONUMENT GRID COORD.: N____ E____ N____ E____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: MATHES
LOG BY: TEI
TRENCH NO.: 12 & 13 (TP 12 & 13)
TRENCH LENGTH: 0 FT TO 50 FT
TRENCH WIDTH:

N 12 13 S

STRATA CHANGE OR WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1 2 3 4 5 6 7 8 9 0	DRUM QUANTITY	REMARK NO.
		Ylw brown silty sand top soil fill		
	5	$CaSO_4$ White with some fracture faces yellow		
		wood, paper, sheet metal — sheet metal — Rubber sheets, wood		
▽	10	$CaSO_4$	Bottom	
		Alka-seltzer Wrapper		
	15			
	20			
	25			

REMARKS:

E-12

TP 12 & 13

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: HIMCO
PROJECT NO.: 20026.023
DATE: 11/30/90
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH: W 14 15 E

SHEET 1 OF 1
EXCAVATOR: Mathes
LOG BY: Tom Puchalski
TRENCH NO.: 14 & 15
TRENCH LENGTH: 0 FT TO 50 FT
TRENCH WIDTH: 5 - 7 ft

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT)	DRUM QUANTITY	REMARK NO.
		Brown to Ylw brn silty sand topsoil - Roots		
		Hardened $CaSO_4$ - White to gray		
		Natural sand buff to brown with black zones 6" thick --6' long, unsaturated	Wood & metal debris	
	5		Flowing water	
			Metal debris	
	10			
	15			
	20			
	25			

REMARKS: Water began pouring frow east end of trench and nearly filled trench by the time the backfill was complete. Rate of discharge did not slow during the 10 minutes of observation.

E-3

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: Himco
PROJECT NO.: 20026.023
DATE: December 1, 1990
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH: NW

SHEET 1 OF 1
EXCAVATOR: Mathes
LOG BY: TEP
TRENCH NO.: TP-16
TRENCH LENGTH: 0 FT TO 25 FT
TRENCH WIDTH: 5 feet

SE

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT)	DRUM QUANTITY	REMARK NO.
		$CaSO_4$		
		Black - wood, paper, bottles, rubber, plastic bags. Trace of sheet metal and metal pipe		
	5			
	10			
		Brownish ylw top soil, fine ground silty sand, roots moist.		
	15			
	20			
	25			

REMARKS: Metal - sheet metal - mirror - one sheet, metal gas can from lawnmower with hole in it, two 1" x 2' metal pipes. Shallow groundwater did not allow deeper excavation.

E-14

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: Himco
PROJECT NO.: 20026.023
DATE: 12/1/90
GRID COORD.: START - N____ E____ N____ E____
END - N____ E____ N____ E____
CONTROL MONUMENT GRID COORD.: N____ E____ N____ E____
ELEVATION, TOP OF TRENCH: W E

SHEET 1 OF 1
EXCAVATOR: JMA
LOG BY: TEP
TRENCH NO.: 17
TRENCH LENGTH: 0 FT TO 25 FT
TRENCH WIDTH: 5

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT)	DRUM QUANTITY	REMARK NO.
		CaSO		
		80% rubber sheets and bands, rest - paper, wood, glass, trace aluminum Photo #1		
	5	Ylw brown silty sand (S17) top soil, roots, moist		
	10			
	15			
	20			
	25			

REMARKS:

E-15

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: Himco
PROJECT NO.: 20026.023
DATE: 12/1/90
GRID COORD.: START - N ___ E ___ N ___ E ___
END - N ___ E ___ N ___ E ___
CONTROL MONUMENT GRID COORD.: N ___ E ___ N ___ E ___
ELEVATION, TOP OF TRENCH: W

SHEET 1 OF 1
EXCAVATOR: Mathes
LOG BY: Tom Puchalski
TRENCH NO.: TP-18
TRENCH LENGTH: 0 FT TO 25 FT
TRENCH WIDTH: 5 ft

E

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT)	DRUM QUANTITY	REMARK NO.
		topsoil $CaSO_4$		
		Municipal Waste & paper, plastic, rubber, glass, cardboard		
		x 1 plastic 55 gal drum		
	5	X - car bumper & other large metal objects		
		(3 x 3 x 5 sheet metal box)		
	10			
	15			
	20			
	25			

REMARKS:

E-16

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: Himco
PROJECT NO.: 20026.023
DATE: 12/1/90
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH: W E

SHEET 1 OF 1
EXCAVATOR: JMA (John Mathes & Assoc.)
LOG BY: TEP
TRENCH NO.: TP-19
TRENCH LENGTH: 0 FT TO 25 FT
TRENCH WIDTH: 5

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1–5	TRENCH LENGTH (FT) 6–10	DRUM QUANTITY	REMARK NO.
		Black organic rich top soil	White $CaSO_4$		
		muffler, drum lids, pail			
	5	Wood, cardboard, trash, bottles, cans,	glass, plastic		
▽	10				
	15				
	20				
	25				

REMARKS:

E-17

TP-19

TRENCH LOG FORM

Donohue

CLIENT: USEPA
PROJECT: Himco Dump
PROJECT NO.: 20026.023
DATE: 12/1/90
GRID COORD.: START - N ___ E ___ N ___ E ___
END - N ___ E ___ N ___ E ___
CONTROL MONUMENT GRID COORD.: N ___ E ___ N ___ E ___
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: JMA
LOG BY: TEP
TRENCH NO.: 20
TRENCH LENGTH: 0 FT TO 25 FT
TRENCH WIDTH: 5 - 8 ft

N S

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 0–10	TRENCH LENGTH (FT) 10–25	DRUM QUANTITY	REMARK NO.
			top soil - brown silty sand		
			$CaSO_4$		
	5	Paper, cardboard, plastic bags, minor glass bottles, wood, black sand			
	10				
			water at interface		
		White to gray $CaSO_4$			
				bottom	
			crumpled sheet metal - Photo #7		
	15				
	20				
	25				

REMARKS:

E-18

1120

E-19

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump
PROJECT NO: 20026.023
DATE: 9/10/91
GRID COORD: START - N ___ E ___ N ___ E ___
END - N ___ E ___ N ___ E ___
CONTROL MONUMENT GRID COORD: N ___ E ___ N ___ E ___
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: Mathes; Mike Donohue
LOG BY: Kim Elias
TRENCH NO.: TD-1
TRENCH LENGTH: 9deep FT TO 22 FT
TRENCH WIDTH: 7

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 2–10	TRENCH LENGTH (FT) 12–22	DRUM QUANTITY	REMARK NO
		Top soil roots numerous 0-9"		0	
	1	0-1' yellow brown sand, poorly graded	by product		
		White, hard powder like	Lime/calcium Alka Seltzer		
		(red bag -	plastic)		
		Brown layer of sand, black plastic bags	blue bags		
	3		wood 1/2" x 6"		
		Garbage Bags	wood		
	4	Black municipal waste, in sand (black)	matrix,		
	5	wires, rubber hose, Tide bottle,	cardboard boxes		
	6	Black, solid sand (sp), w/gravel m-l	g,		
	7	foam pad Matrix of bl	ack, viscous material (slag)		
	8	(* bubbles)	water flowing in		*
		8.5 ft water in black water to 9',	filling hole to 6.8'		
	9				
	25				

REMARKS: Water, leachate, filling in hole, from 8.5 ft to 6.8 ft and rising when hole filled.
Bubbles of gas noted* Avg. OVA 12 ppm in BZ
max 100 ppm approx. 6' in depth

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump, Phase II
PROJECT NO: 20026.023
DATE: 9/10/91
GRID COORD: START - N ______ E ______ N ______ E ______
END - N ______ E ______ N ______ E ______
CONTROL MONUMENT GRID COORD.: N ______ E ______ N ______ E ______
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: Mathes; Mike Donohue
LOG BY: Kim Elias
TRENCH NO.: TD-2
TRENCH LENGTH: 4.5 FT TO 20 FT
TRENCH WIDTH: 7

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 2 – 10	TRENCH LENGTH (FT) 12 – 20	DRUM QUANTITY	REMARK NO.
		Top soil, brown silty sand, numerous roots 0-6"			
	1	Sand with gravel small to large / concrete slab 2' x 4' /			
		concrete slab 2' x 3'			
	2	Bricks, rubbel, black sand	bricks, concrete		
		Brown sand matrix cobbles,	wood, wood logs		
	3	cinder block	Beer cans, rubber		
		plywood	blue bags		
	4	Wood, 1/2" x 6"	black sand?		
		(water at 4 ft)	black leachate		

REMARKS: Water at 4 ft - back, no bubbles and not rising
OVA readings averaged 4 ppm throughout excavation, 300 ppm in BZ when water reached

E-20

E-21

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Nimco Dump Phase II
PROJECT NO.: 20026.023
DATE: 09-11-91
GRID COORD.: START - N ______ E ______ N ______ E ______
END - N ______ E ______ N ______ E ______
CONTROL MONUMENT GRID COORD.: N ______ E ______ N ______ E ______
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: Mathes;Mike Donohue
LOG BY: K. Elias
TRENCH NO.: TD-3
TRENCH LENGTH: 16 FT TO 14 FT deep
TRENCH WIDTH: 7'

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 0 – 8	TRENCH LENGTH (FT) 8 – 16	DRUM QUANTITY	REMARK NO.
		yellow brown sand (SP) topsoil	0-6" roots	0	
	1	(trace white calcium)			
		trace black soil			
	2	white calcium/lime powder, or	fine material w/ trace black soil		
		bottles	white powder, hard		
	3	black soil			
		roots,			
	4	mottled white w/ trace	black,		
	6	black, asphalt like material	sand matric - moist.		
		tar like - but not viscus			
	8	mottled white and black,	asphalt like sand base		
		moist, - sludge gray	not solid or hard but		
	10		soft-medium samd (SP)		
		mottled white & black			
	12				
	14	water/leachate, pared in - spotty areas			
		14.5 brown organic base, siltry w/ trace sand - ok			
	25				

REMARKS: Black asphalt or tar material has sand matrix with bituminous mixture
Water near base 14 ft, spotty & pouring in - slowly. Top soil placed on top of back filled trench
Brown organic material at base = 14.5' - neutral material. The rest was fill.
No. debris.
OVA avg. 20-30 ppm in BZ 100 ppm max. in BZ

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump , Phase II
PROJECT NO: 20026.026
DATE: 09-11-91
GRID COORD: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: Mathes;C.G.
LOG BY: K. Elias
TRENCH NO.: TD-4
TRENCH LENGTH: 15 FT TO 11 FT deep
TRENCH WIDTH:

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1–5	TRENCH LENGTH (FT) 6–0	DRUM QUANTITY	REMARK NO.
		brown sand dry/ glass bottles;100ml/	wood	0	
	1	debris wood /filled white			
		bricks plastic sheets, (pharmacy)	Bottles, glass clear & brown		
	2				
		wood 6"x1/2" plastic sheets,	numerous bricks, wires		
	3	sand, content increasaing, occasional debris			
	4				
	5				
	6	sand, brown (SP) fill trace of			
	7	glass, bricks, wood, plastic sheets			
	8				
	9				
	10				
	11	Wet, gray sand - fine to coarse (SW)			

REMARKS:

Water @ 11 ft. Debris 6" to 5 ft. heavy & sand increase beyond 5 ft.
No ova readings at any time.

E-22

E-23

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump, Phase II
PROJECT NO: 20026.023
DATE: 09-11-91
GRID COORD: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: Mathes
LOG BY: K. Elias
TRENCH NO.: TD-5
TRENCH LENGTH: 14 FT TO 9 FT deep
TRENCH WIDTH: 7'

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1 – 8	TRENCH LENGTH (FT) 10 – 14	DRUM QUANTITY	REMARK NO.
		Dark brown siltry sand, 0-6" topsoil			
	1	trace brick trace wood			
		sand			
	2		metal wire		
		bricks - numerous wood debris	, construction debris		
	3	minor sand, bricks wires			
		concrete, bricks wood	plastic tubes, under block		
	4				
		wood, dry, little sand matric	radiator		
	5				
	6				
	7				
	8				
	9	end of wood & bricks - gray sandy silt			

REMARKS:
house debris, no water noted
no ova readings at any time during this excavation

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump, Phase II
PROJECT NO: 20026.023
DATE: 09-11-91
GRID COORD.: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: Mathes; M. Donohue
LOG BY: K. Elias
TRENCH NO.: TD6
TRENCH LENGTH: 16 FT TO 4.5 FT deep
TRENCH WIDTH: 7'

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 2 – 8	10 – 16	DRUM QUANTITY	REMARK NO.
		brown silty sand w/ garbage: glass, plastic, cans, wood, debris, 0-1.5			
	1	brick			
		1.5 sal., dark brown - black, bricks	sand		
	2	concrete wood log	concrete trace asphalt		
		rubber flipper trace asphalt blade bituminous sand and gravel			
	4	sand-	concrete 4'x3'x3'		
		trace asphalt concrete 4'x3' tire (water pocket)			
	20				
	25				

REMARKS: pocket of water @ 4' rubbel appeared to decrease or end @ 4.5"
Avg. 10 ppm in BZ, Max of 60ppm in BZ

E-24

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump
PROJECT NO: 20026.023
DATE: 09-13-91
GRID COORD: START N ___ E ___ N ___ E ___
END N ___ E ___ N ___ E ___
CONTROL MONUMENT GRID COORD.: N ___ E ___ N ___ E ___
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: Mathes;C. Goodwin
LOG BY: K. Elias
TRENCH NO.: TL-1
TRENCH LENGTH: 1.5 FT TO 12 FT
TRENCH WIDTH: 7'

STRATA CHANGE OR WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1–5	TRENCH LENGTH (FT) 6–0	DRUM QUANTITY	REMARK NO.
		0-1ft topsoil, dark brown silty sand,	trace gravel		
	1	root/ets, noist, organic		1	
		mottled, unevenly layered white calcium	carbonate cl ft	OVA	
	2	debris: drum=flattened, concrete, glass	, metal sheeting	=20	
		black material - silty sand matrix syri	gens, wood	PPM	
	3	rubber matting, insulation - stained bl	ack		
			(leachate seeping in) Debris = 80%		
	4	black bags of municipal garbage, rolls	of insulation		
	5	alkaselser wrapper, glass	carboard, plastic		
	6				
			DRUM bent, opened		
	7	leachate - black pouring in	white filled w/ debris		
		at 8 ft. above the	leachate		
	8	layer of =	gray/white sludge material		
	10				
	12				
	25				

REMARKS:

Level B trenching - see photos. Leachate was black, thick, oil sheen
OVA averaged 100ppm

E-25

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump
PROJECT NO: 20026.023
DATE: 09-13-91
GRID COORD: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH

SHEET 1 OF 1
EXCAVATOR: Mathes
LOG BY: K. Elias
TRENCH NO.: TL-2
TRENCH LENGTH: 1.3 FT TO 8.5 FT deep
TRENCH WIDTH: 7'

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1 2 3 4 5 6 8 10 12 13	DRUM QUANTITY	REMARK NO.
		silty sand rop soil 0 - 1ft., roots gravel	PPM	
	1		OVA	
		plastic by products 1' thick laues - pushed out		
	2	white line/ calcium carbonate - powder like, hard	30ppm	
		water pouring in at spots @ 2.5 ft & 3ft		
	3	black soil rubbel: bottles, plastic strips, bags, wood		
		cardboards	60ppm	
	4	waterfill to 4ft., black water, let fill trench pre sampling		
	5	black soil: w/ rubbel, wet, rubbel 45% of trench		
			200ppm	
	6	logs		bucket
	7			
	8			
	20			
	25			

REMARKS: Level B. Trench, leachate collection. mills sampling also
OVA Average ~100ppm in BZ
Water filled in from several seap areas int he trench

E-26

E 27

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump/Phase II
PROJECT NO: 20026.023
DATE: 09-12-91
GRID COORD: START · N ____ E ____ N ____ E ____
END · N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR Mathes
LOG BY: K. Elias
TRENCH NO: TL-3
TRENCH LENGTH: 15 FT TO 19 FT deep
TRENCH WIDTH: 8'

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1 – 15	DRUM QUANTITY	REMARK NO.
		Brown moist. sand with trace silt, roots, topsoil		
	1			
		(SP) fill		
	2	sand, brown, fix - medium , bricks numerous		
		black soil or asphalt and sand mixture		
	3			
		blue/black material - sand mixture w/ gravel		
	4	may have asphalt or petroleum or bituminous mixture in sand		
		mutted, black/brown sand moist.		
	5	metal, drum flattened cobbles, heulters		
	6	moist/wet gray sand (SW) fine - coarse		
	7	builders /wood 1/2' x 6' / logs / bricks/ w/ blk sd.		
	8			*
	9	gray brown sand, moist., trace gravel		**
	10			
	11	no debris		
	12			
	13			
	14			
	15	trace water infiltrating in @15ft (caning in, therefore		
		widen trench)		

REMARKS: * 8ft 20 ppm on OVA - Breathing zone, ** = 100ppm on OVA Breathing zone
collected soil samples @ 2ft & 6ft intervals
bottom at 19ft, could not go deeper, would cave back in & up to 16ft

Leachate sample not collected due to cave in

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump/Phase II
PROJECT NO: 20026.023
DATE: 09-12-91
GRID COORD: START - N ____ E ____ N ____ E ____
END - N ____ E ____ N ____ E ____
CONTROL MONUMENT GRID COORD.: N ____ E ____ N ____ E ____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR Mathes
LOG BY: K. Elias
TRENCH NO: TL-4
TRENCH LENGTH 14 FT TO 6 FT deep
TRENCH WIDTH 6'

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1 2 3 4 5	8 9 10 12 14	DRUM QUANTITY	REMARK NO.
		black brown organic topsoil, silty sand	w/ numerous rootlets		
	1				
		sand w/ silt & gravel sark brown/black,	numerous bricks, wood		
	2	bricks, wood, metal pipes, debris			5ppm
		concrete slab			
	3	in sand matrix			
	4				
	5	water pouring in @ 5ft, - filled to 4.5			10ppm
		bottom hole 6ft			
	15				
	20				
	25				

REMARKS:

Collected leachate samples & duplicates. Level B protection
Note: water flowed into trench at one spot (6"x4"). The flow was steady till 4.5 ft.

OVA averaged 5-10ppm in BZ.

E-28

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump
PROJECT NO: 20026.023
DATE: 09-13-91
GRID COORD.: START - N ___ E ___ N ___ E ___
END - N ___ E ___ N ___ E ___
CONTROL MONUMENT GRID COORD.: N ___ E ___ N ___ E ___
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: Mathes
LOG BY: K. Elias
TRENCH NO: TL-5
TRENCH LENGTH: 15 FT TO 12 FT deep
TRENCH WIDTH: 7'

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 1 2 3 4 5 6 7 8 9 0	DRUM QUANTITY	REMARK NO.
		brown silty topsoil, roots, gravel tree	WA	
	1			
		rubbel bent drum empty	30ppm	
	2	wood sheetings, plastic debris	=AVG	
		DRUM		
	3	black, black material, asphalt mixture w/ sand base layer	max=	
		stay like	100ppm	
	4	water seeping in slowly at one spot smashed		
		DRUM		
	5	sandy - brown & black		
	6	leachate filling in - red/brown thick		
	8	water/leachate sand - tan		
	10			
	12	GRAY TAN SD		
	25			

REMARKS: Leachate collected in level B. Thick red brown (product) leachate, oil sheen, shina.

E-29

TRENCH LOG FORM

CLIENT: U.S. EPA
PROJECT: Himco Dump
PROJECT NO: 20026.023
DATE: 09-13-91
GRID COORD: START - N___ E___ N___ E___
END - N___ E___ N___ E___
CONTROL MONUMENT GRID COORD.: N___ E___ N___ E___
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: Mathes
LOG BY: K. Elias
TRENCH NO: TL-6
TRENCH LENGTH: 15 FT TO 14 FT deep
TRENCH WIDTH: 7'

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 2 · 4 · 8 · 10 · 15	DRUM QUANTITY	REMARK NO.
		brown silty sand, trace gravel, roots, moist./topsoil	OVA	
	1		20	
		rubbel; black, plastics, cardboards, insulation, sand matrix, black		
	2		B.Z.	
		black, plastics, sheets, 1/2" thick, rubbel 80% (water packet)	70ppm	
	3	rubbel		
	4	tan sand		
	5	gray tan sand (SP) f - medium, trace coarse		
		trace gravel		
	6			
	7			
	8			
	10			
	12			
	14			
	25			

REMARKS:

No leachate collected, Rubbel 2-4ft., leachate was seeping in at two areas, slowly. Notsufficient to collect a sample

~~* 70ppm in breathing zone 15ft. from trench~~

E-31

TRENCH LOG FORM

Donohue

CLIENT: U.S. EPA
PROJECT: Himco Dump , Phase II
PROJECT NO.: 20026-023
DATE: 09-13-91
GRID COORD.: START - N_____ E_____ N_____ E_____
END - N_____ E_____ N_____ E_____
CONTROL MONUMENT GRID COORD.: N_____ E_____ N_____ E_____
ELEVATION, TOP OF TRENCH:

SHEET 1 OF 1
EXCAVATOR: Mathes;C.G.
LOG BY: K. Elias
TRENCH NO.: TL-7
TRENCH LENGTH: 17 FT TO 15 FT deep
TRENCH WIDTH: 7'

STRATA CHANGE OF WATER LEVEL	DEPTH	TRENCH LENGTH (FT) 2	4	6	7	8	9	10	12	15	17	DRUM QUANTITY	REMARK NO.
		(SP) silty sand, brown, damp, roots										0	
	1		(glass bottle)										
		mottled yellow brown (gray sand)				reddish brown							
	2												
	3	gray sand, mottled											
	4			light tans sand, f - m fill									
	5												
	6												
	7	plastic bag-black											
	8												
	9												
	10												
	12												
	14	gray, well graded sand											
	15												

REMARKS: No water in hole, 15ft. deep, sand caved in : 1:1 grade
No leachate sample located

APPENDIX F

REMEDIAL ACTION

HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX F
COMPARATIVE ANALYSIS OF COVER SYSTEM ALTERNATES

US Army Corps
of Engineers
Omaha District

HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

COMPARATIVE ANALYSIS OF COVER SYSTEM ALTERNATIVES

Prepared for

USEPA REGION V
CHICAGO, IL

NOVEMBER, 1994

F - 2

TABLE OF CONTENTS
HIMCO DUMP
COMPARATIVE ANALYSIS OF
COVER SYSTEM ALTERNATIVES

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HIMCO DUMP
COMPARATIVE ANALYSIS OF
COVER SYSTEM ALTERNATIVES

FIGURES

APPENDICES

composite systems. The Modified Geomembrane/Clay cover was eliminated from consideration due to its higher costs. The Geomembrane cover, is the least expensive, and is the only acceptable single barrier system under consideration. The final selection of the cover system should be based on whether the slightly better performance and additional confidence derived from the composite Geomembrane/GCL would offset the cost of the more economical Geomembrane cover.

An approximate breakout of the cost of the cover components versus the cost of the entire project show a range for the five alternatives analyzed between 36% - 46%.

Potential cost saving measures which could be incorporated into the project design include: 1) Using onsite borrow for the random fill. This would result in a savings of approximately $750,000. In addition, the borrow area could be designed in a manner which would create wetland habitat. 2) Removing construction debris and excavating surface contaminated soil from the south central portion of the site and relocating this material to on top of the landfill proper. This would reduce the amount of random fill which would be required and decrease the area of the cover by 10 acres. This would result in a cost savings of approximately $1,500,000.

composite geomembrane/compacted clay cover with a sand drainage layer; 3) a geomembrane cover with a geonet drainage layer; 4) a composite geomembrane/geosynthetic clay liner (GCL) cover with a geonet drainage layer; and 5) a modified composite geomembrane/compacted cover with a sand drainage layer. Cross sections 1 and 2 are the two cover systems proposed in the FS. Cross sections 3, 4, and 5 are alternative cover systems which will also be evaluated. Schematic diagrams of these cross sections are shown on Figure 1.

4. **METHOD OF ANALYSIS.** The Hydrologic Evaluation and Landfill Performance (HELP) model was used to evaluate the hydrologic efficiency of the cover systems. Models were run for all cross sections, including cross sections 1 and 2 which had HELP model evaluations performed in the FS. However, direct comparison of the HELP model results from this document and the FS cannot be made due to the following reasons:

- The cross sections input into the HELP model in this document will not include the waste layer. The evaluation of the alternatives will be based on the amount of precipitation infiltrating through the low permeable layer, thus eliminating the effects of unpredictable landfill waste properties from the analysis.

- The drainage layer, which is a key component to any landfill cover, will be input into the model.

- A lower SCS runoff curve number will be used. The curve numbers used in the FS, ranging between 87 and 95, are not appropriate for a vegetative cover. These numbers would erroneously overestimate the amount of runoff; thus, underestimating the amount of infiltration.

- Layer 1 of cross sections 1 and 2 was modeled as 12 inches thick in the FS, rather than 18 inches as described in the text of the FS.

Cost estimates were made for the cover materials, from the topsoil down to the low permeable layer for all four cover systems being analyzed. All other features, which would remain constant for the various covers, were not included in the estimates. These estimates are to be used for a relative comparison of the systems only.

5. COVER SYSTEM ANALYSIS.

5.1. <u>Clay Cover (Cross Section 1).</u> The clay cover consists of an 18 inch vegetated soil layer, a 6 inch sand drainage layer, and two feet of compacted clay with a hydraulic conductivity of 1×10^{-7} cm/sec. This cover would prove to be the least effective of the cover systems analyzed in terms of limiting infiltration into the waste materials. The primary reasons for the reduced effectiveness of this cross section is that it lacks an adequately sized drainage layer, the low-permeable clay layer is not located below frost depth, and there is not a sufficient cover over the clay layer to protect the clay layer from desiccation cracking.

The 6 inch thick drainage layer is inadequate. The EPA "Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments" (EPA/530-SW-89-047), states that a granular drainage layer should have a minimum thickness of 12 inches and a minimum hydraulic conductivity of 1×10^{-2} cm/sec. A drainage layer with adequate flow carrying properties is critical in controlling the amount of percolation through the low permeability layer, and thus greatly reducing the amount of potential leachate generated by the landfill. If precipitation which infiltrates through the cover soils is diverted off of the low permeability layer and not allowed to build up, percolation through this layer will not take place. In addition, a geotextile should be placed between the cover soils and the drainage layer to prevent fines from entering into, and clogging the drainage layer.

The HELP model shows that with Cross Section 1, the 18 inches of cover soils would become completely saturated during periods of heavy rainfall. This increases the amount of percolation through the low permeability layer, and would create slope stability concerns in the upper soil layers on the steeper side slopes. The presence of an adequately sized drainage layer would alleviate both of these problems.

A compacted clay layer should always be placed below maximum frost penetration. The hydraulic conductivity of a low permeability clay layer is greatly affected due to cracking of the clay layer after just a few freeze-thaw cycles. Instead of an as-constructed hydraulic conductivity of 1×10^{-7} cm/sec, values in the range of 1×10^{-6} to 1×10^{-5} cm/sec is all that could be anticipated over the long term. This phenomenon is described by Chamberlain, E. J., Iskandar, I., and Hunsicker, S. E. (1990), "Effect of Freeze-Thaw Cycles on the Permeability and Macrostructure

5.3. Geomembrane Cover (Cross Section 3). The geomembrane cover would be constructed with six inches of topsoil, 18 inches of select fill, a geotextile filter, a geonet, and a 40 mil geomembrane.

The specified thicknesses for the topsoil and select fill are required to protect the geosynthetics during construction and to provide an adequate root zone for the vegetative cover. Providing a soil cover to frost depth is not a concern with this cover system since there are presently no indications that freeze-thaw cycles adversely affect the properties of geomembranes. The geonet was designed to maintain the amount of head buildup on top of the geomembrane to within the thickness of the geonet. This will help to minimize the amount of percolation into the waste, and prevent the cover soils from becoming saturated, which will improve the stability of the side slopes. A geotextile filter will be placed immediately above the geonet to prevent fines from migrating into, and clogging the geonet.

The HELP model shows that the geomembrane cover system essentially prevents any percolation through the geomembrane, allowing only 0.22% of the average annual precipitation through the cover system. This percolation is due to a liner leakage factor which is input into the HELP model to simulate any minor imperfections which may be present in the geomembrane or seams.

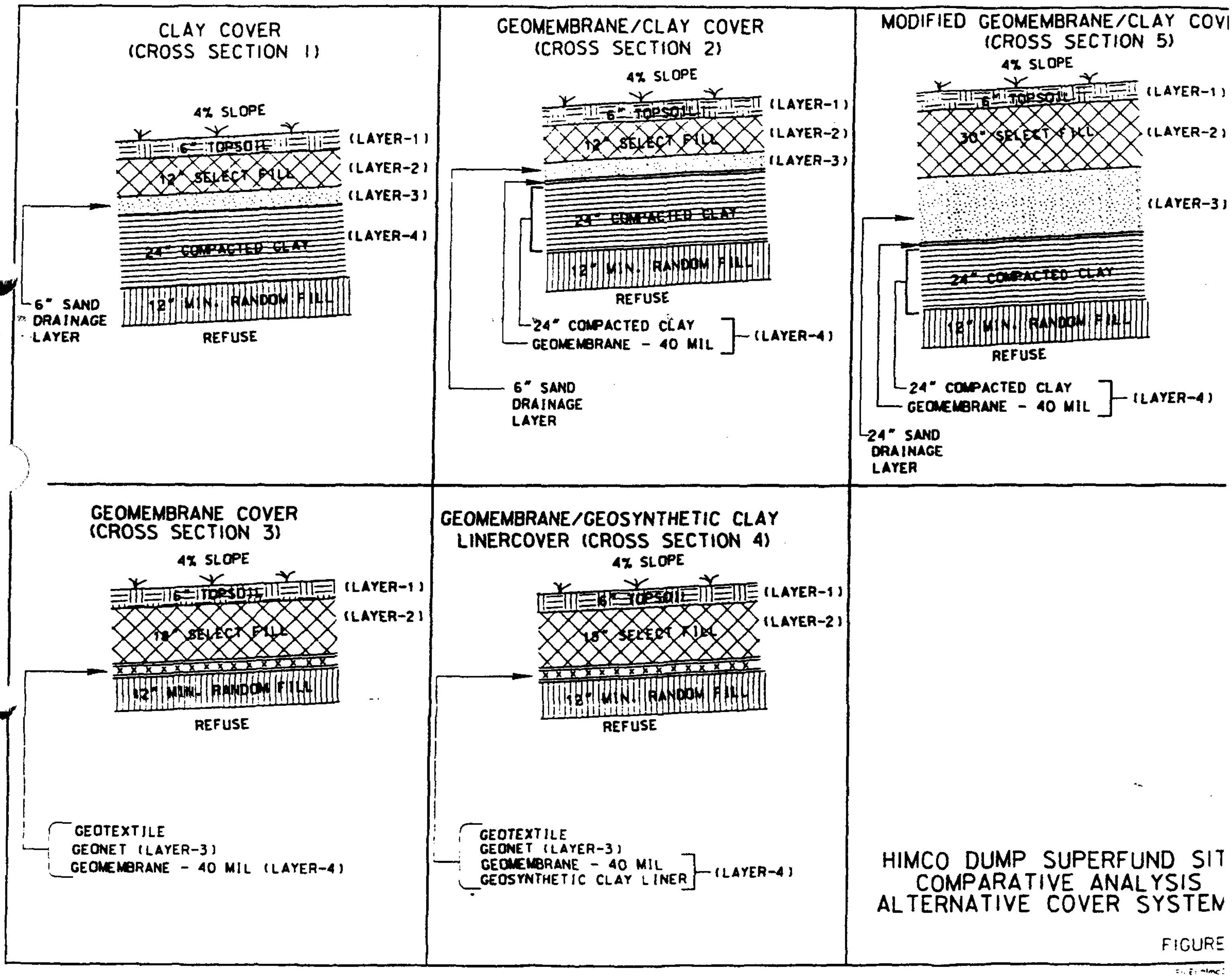
5.4. Composite Geomembrane/Geosynthetic Clay Liner (GCL) Cover (Cross Section 4).

This cover system consists of six inches topsoil, 18 inches of select fill, a geotextile filter, a geonet, a geomembrane, and a GCL.

GCLs consist of a thin bentonite clay layer sandwiched between two geotextile layers. The hydraulic conductivity of a GCL will range from $1x10^{-8}$ to $1x10^{-10}$ cm/sec. The hydraulic conductivity of the GCL used in this analysis is $1x10^{-9}$ cm/sec.

GCLs are normally used directly underneath a geomembrane, replacing the compacted clay layer in RCRA Subtitle C covers; however, they can also be utilized as the primary low permeability layer.

There are certain situations where GCLs perform better than compacted clay: when exposed to freeze-thaw conditions, wet-dry conditions, or when total or differential settlement


CLAY COVER
(CROSS SECTION 1)
4% SLOPE
6" TOPSOIL (LAYER-1)
12" SELECT FILL (LAYER-2)
(LAYER-3)
24" COMPACTED CLAY (LAYER-4)
12" MIN. RANDOM FILL
REFUSE
6" SAND DRAINAGE LAYER
GEOMEMBRANE/CLAY COVER
(CROSS SECTION 2)
4% SLOPE
6" TOPSOIL (LAYER-1)
12" SELECT FILL (LAYER-2)
(LAYER-3)
24" COMPACTED CLAY
12" MIN. RANDOM FILL
REFUSE
24" COMPACTED CLAY
GEOMEMBRANE - 40 MIL
(LAYER-4)
6" SAND DRAINAGE LAYER
MODIFIED GEOMEMBRANE/CLAY COV
(CROSS SECTION 5)
4% SLOPE
6" TOPSOIL (LAYER-1)
30" SELECT FILL (LAYER-2)
(LAYER-3)
24" COMPACTED CLAY
12" MIN. RANDOM FILL
REFUSE
24" COMPACTED CLAY
GEOMEMBRANE - 40 MIL
(LAYER-4)
24" SAND DRAINAGE LAYER
GEOMEMBRANE COVER
(CROSS SECTION 3)
4% SLOPE
6" TOPSOIL (LAYER-1)
18" SELECT FILL (LAYER-2)
12" MIN. RANDOM FILL
REFUSE
GEOTEXTILE
GEONET (LAYER-3)
GEOMEMBRANE - 40 MIL (LAYER-4)
GEOMEMBRANE/GEOSYNTHETIC CLAY
LINERCOVER (CROSS SECTION 4)
4% SLOPE
6" TOPSOIL (LAYER-1)
18" SELECT FILL (LAYER-2)
12" MIN. RANDOM FILL
REFUSE
GEOTEXTILE
GEONET (LAYER-3)
GEOMEMBRANE - 40 MIL
GEOSYNTHETIC CLAY LINER
(LAYER-4)
HIMCO DUMP SUPERFUND SIT
COMPARATIVE ANALYSIS
ALTERNATIVE COVER SYSTEM
FIGURE

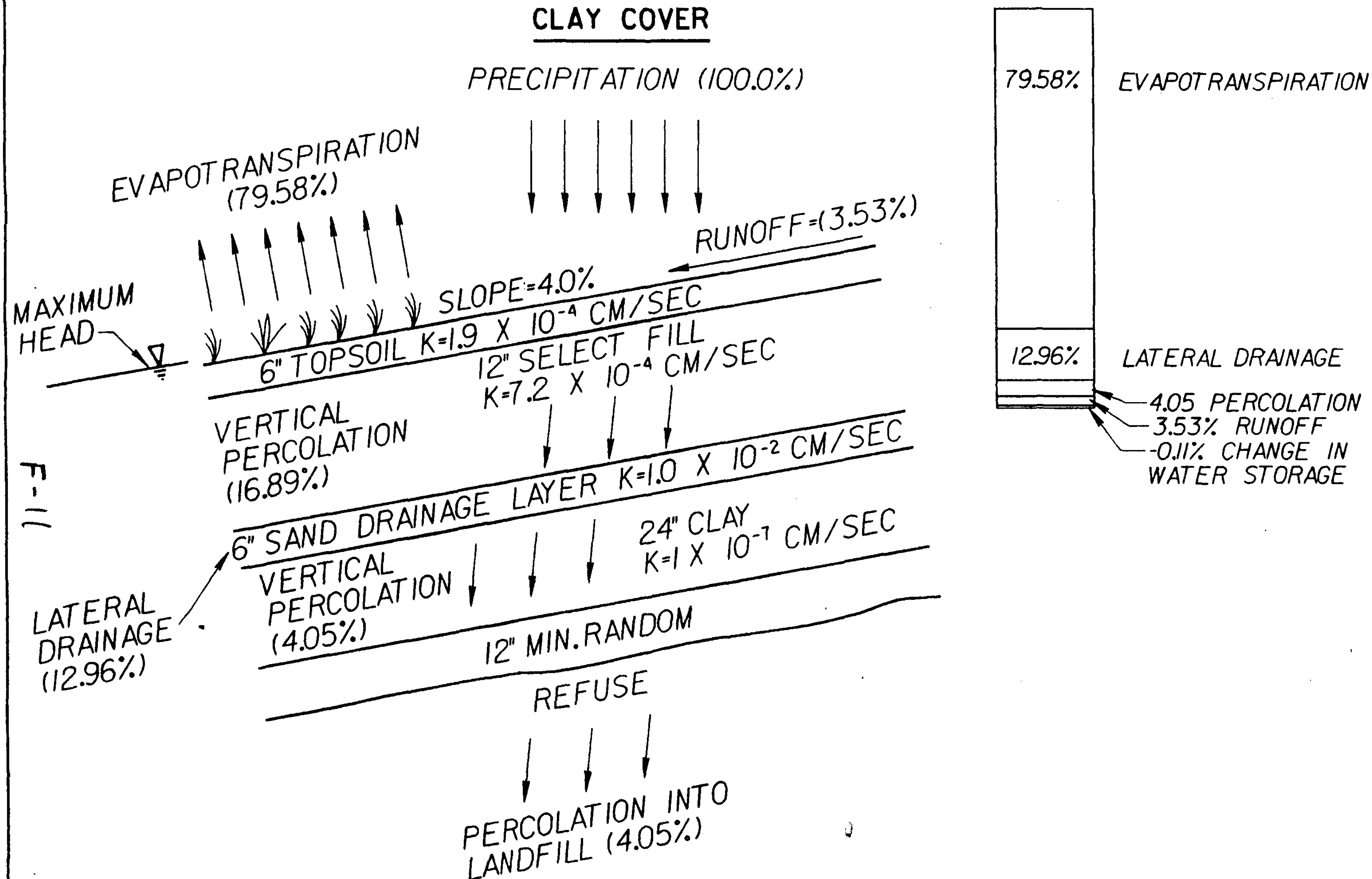
A geotextile filter was also included in this cross section, placed between the select fill and drainage layers. This will prevent the migration of fines from the select fill from entering into, and clogging the drainage layer.

The HELP model shows that Cross Section 5 would not allow any percolation into the waste materials.

5.6. Summary of Cover System Effectiveness. The Clay cover system, which was proposed in the FS, is the least effective of the cover systems analyzed and is not recommended. This is due to the lack of an adequately sized drainage layer, and the lack of frost protection for the compacted clay layer. After repeated freeze-thaw cycles, the clay layer will develop cracks and gradually lose its effectiveness in preventing percolation through the cover system. This, coupled with the lack of an effective drainage layer, will result in more leachate being generated and entering the groundwater than with the other cover systems. The flow capacity concerns of drainage layer are compounded by the lack of a filter which would prevent the drainage layer from clogging over time. These concerns are also valid for the Geomembrane/Clay cover system, which was also proposed in the FS. The effectiveness of this cover system is questionable, and also would not be recommended for use. In addition to the clay layer being rendered ineffective after repeated freeze-thaw cycles, the integrity of the geomembrane would always be in question due to the potential for damage during construction of the drainage layer. This problem is created by an insufficient lift thickness above the geomembrane.

The Geomembrane, Geomembrane/GCL, and the Modified Geomembrane/Clay cover systems which are presented in this document, demonstrate superior effectiveness over the Clay cover, and equal effectiveness when compared with the Geomembrane/Clay cover system, but with a much higher level of confidence. The Geomembrane, Geomembrane/GCL, and Modified Geomembrane/Clay cover systems are similar in performance based on HELP modeling. The major advantage for using one of the composite cover system would be for the additional level of protection that the GCL or compacted clay would provide if the geomembrane would ever be damaged.

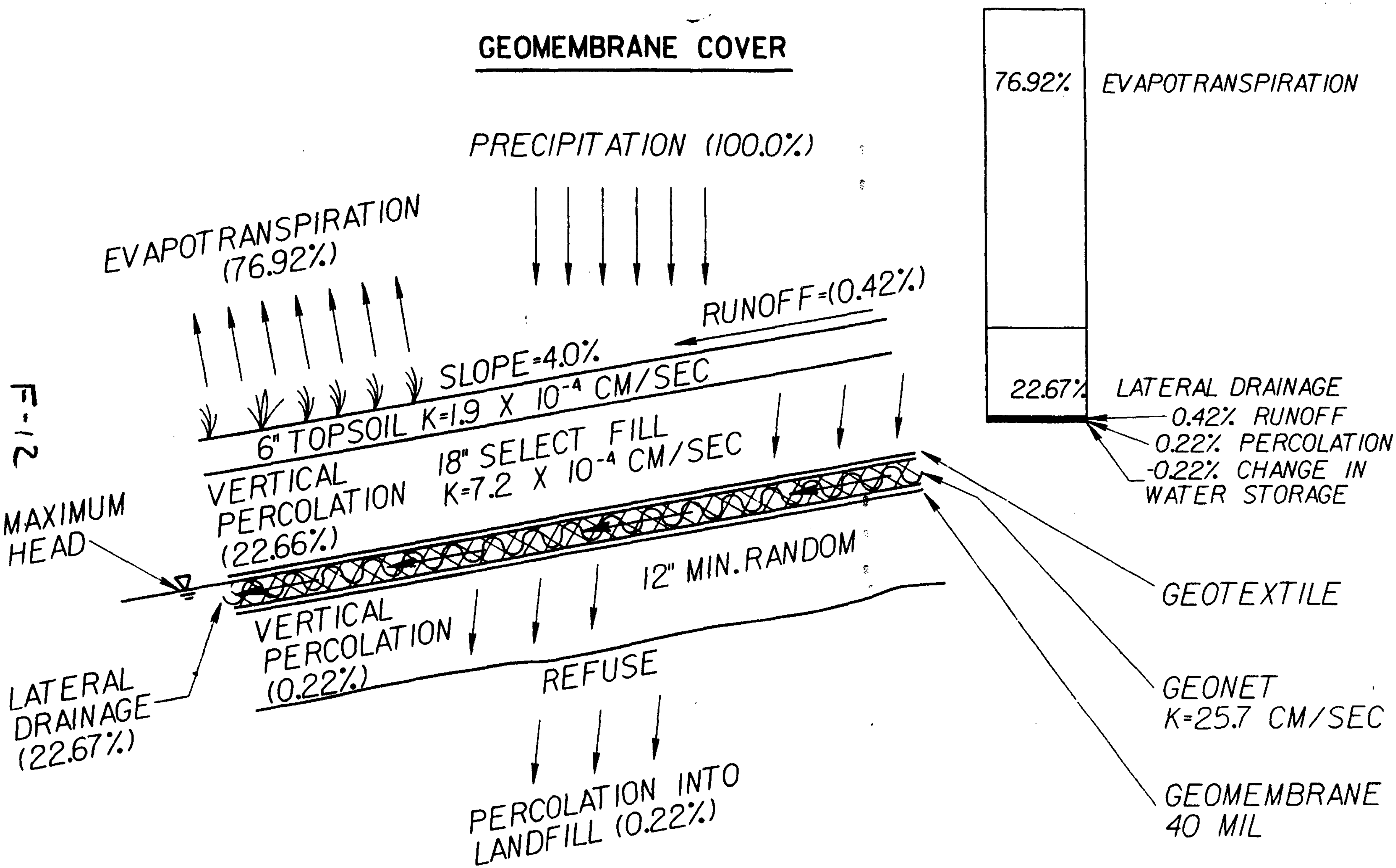
Figure 2 graphically shows the average annual percolation through the covers as a percentage of the average annual precipitation. Water balance diagrams for the various systems



WATER BALANCE SCHEMATIC
BASED ON AVERAGE ANNUAL TOTALS

HIMCO DUMP SUPERFUND SITE
FIGURE 3

GEOMEMBRANE COVER

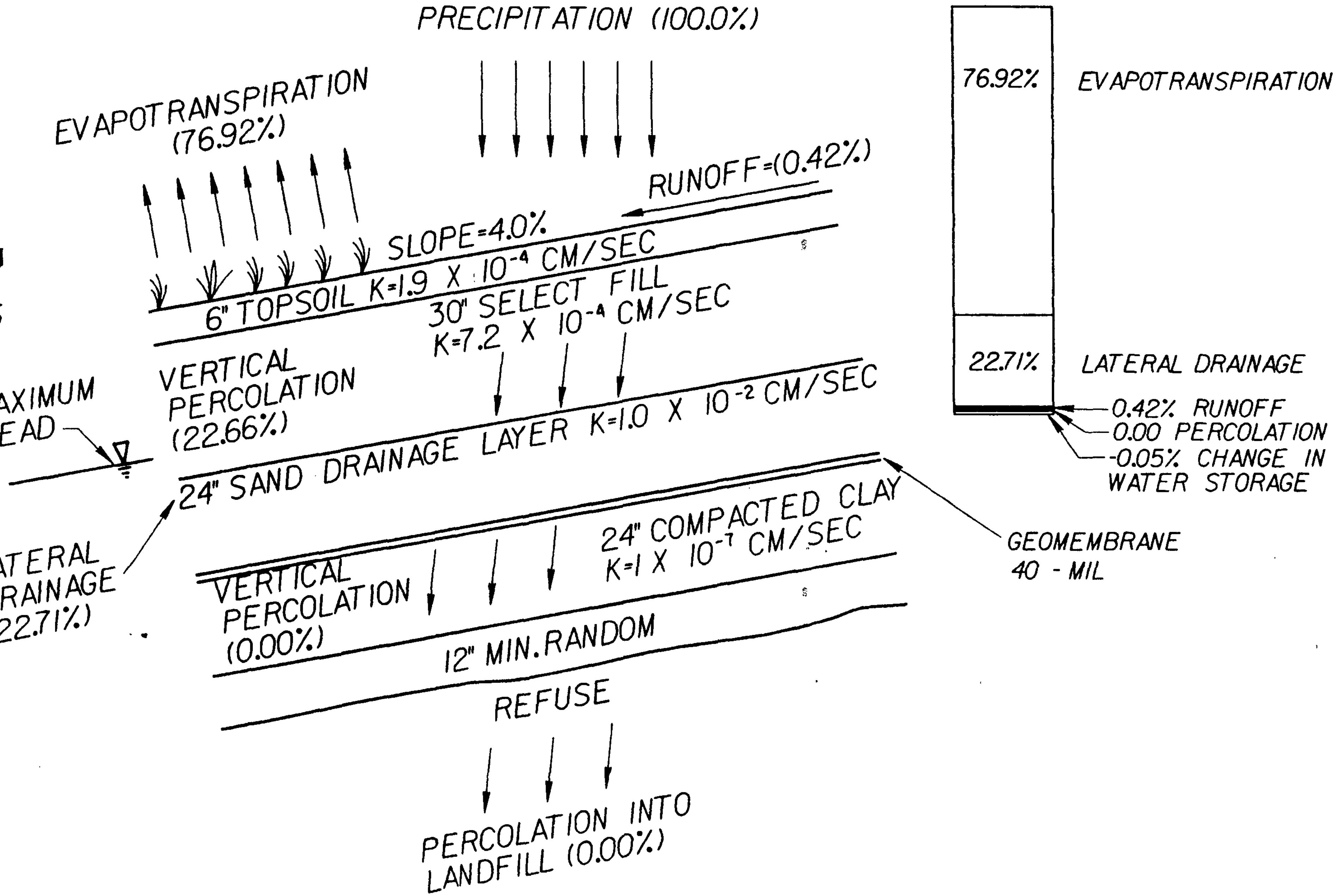


WATER BALANCE SCHEMATIC
BASED ON AVERAGE ANNUAL TOTALS

HIMCO DUMP SUPERFUND SITE
FIGURE 5

MODIFIED GEOMEMBRANE/[illegible] COVER

F-13



WATER BALANCE SCHEMATIC

BASED ON AVERAGE ANNUAL TOTALS

HIMCO DUMP SUPERFUND SITE

FIGURE 7

costs are escalated to represent December 1995 dollars.

Cover	Cost/Acre
Clay Cover (Cross Section 1)	$46,773.
Geomembrane/Clay Cover (Cross Section 2)	$71,494.
Geomembrane Cover (Cross Section 3)	$70,832.
Geomembrane/GCL Cover (Cross Section 4)	$106,104.
Modified Geomembrane/Clay Cover (Cross Section 5)	$119,336.

A review of the cost estimates in Appendix B assists in understanding the tradeoff of costs between cover components in the various systems. For example: Cross Sections 2 and 3 are quite different in components, although they are nearly equal in cost. A major cost in Cross Section 2 is the clay layer. Cross Section 3 does not have a clay layer; however, it has additional costs with a geotextile, six inches additional select fill, and the additional cost of a geonet in lieu of the six inch sand drainage layer.

The only difference in cost between Cross Sections 3 and 4 is the additional cost of the GCL, which is approximately $35,000/acre.

The increase in costs of Cross Sections 5 over Cross Section 2 is what would be required to make Cross Section 2 an acceptable system. This includes thicker select fill and sand drainage layers, and a geotextile filter.

The GCL used in Cross Section 4 is more expensive than the clay in Cross Section 5; however, the additional select fill, and the 24 inches of sand versus a geonet makes Cross Section 5 a more expensive system.

6.4. Non-estimated Items. There are many construction features that are not covered in these cost estimates. However, since these items would be a constant for all cross sections, their exclusion does not affect the comparison of alternatives. Many of these items could not be accurately estimated until their need and/or design is completed.

- Actual random fill required to bring cover to final grade
- Gas collection system
- Seeding
- Shaping, removal, clearing and grubbing

the same manner. The difference in cover component cost between this system and the Geomembrane/Clay cover is $48,000. By increasing the total project cost/acre of the known Geomembrane/Clay estimate by $48,000, an approximate total cost for the Modified Geomembrane/Clay cover was obtained.

Cover	Cover Cost/ Acre	Approx. Total Project Cost/Acre	%
Clay Cover	$46,773.	$130,000.	36%
Geomembrane/Clay	$71,494.	$235,000.	46%
Geomembrane	$70,832.	$235,000.	46%
Geomembrane/GCL	$106,104.	$270,000.	39%
Mod. Geomembrane/Clay	$119,336.	$283,000.	42%

9. **RELOCATION OF WASTE MATERIAL.** Construction debris and surface contaminated soils from the south central portion of the site could potentially be relocated and placed on the landfill proper. This would limit the amount of random fill which would be required and decrease the area of the cover by 10 acres. This would result in a cost savings of approximately $1,500,000. A review of the actual type and size of debris would need to be made to better determine the feasibility of this proposal. A review of the Remedial Investigation Report to verify the depth and lateral extent of soil contamination in this area should also be performed.

10. **ENVIRONMENTAL MITIGATION.** An environmental mitigation feature, which would also have a significant cost savings to the overall project, should be given consideration during the design phase. The construction of a cover system will normally increase both the total volume and the peak discharge of surface runoff leaving a site. To minimize the effects of the increased runoff, and the potential downstream impacts of increased sedimentation in nearby waterways both during construction and during normal project operations, a detention structure is normally constructed capable of storing a 25-year storm event.

Currently it is being proposed to obtain 190,300 of random fill (or the buffer layer as it referred to in the FS) at an off-site location at a cost of $5.00/ for the material and hauling. Since the Himco Dump is 58 acres in size, located on a 100 site, sufficient area is available to

The Modified Geomembrane/Clay cover system corrects the deficiencies encountered in the Geomembrane/Clay cover. These improvements include: 1) additional select fill to provide frost protection for the clay layer, 2) the placement of a filter immediately above the drainage layer, and 3) increasing the thickness of the drainage layer to provide protection to the geomembrane and to provide adequate internal drainage. However, due to making these corrections, the Modified Geomembrane/Clay cover becomes the most expensive cover analyzed in this document. Due to the cost of this system, it was eliminated from consideration.

The Geomembrane/GCL cover is the most effective cover system analyzed in this document. This cover system, properly constructed, will not allow any percolation into the refuse and is slightly more effective than the Geomembrane cover, but at an additional cost of approximately $35,000/acre. The GCL also provides an additional level of confidence derived from a composite cover.

The Geomembrane, Geomembrane/GCL, and the Modified Geomembrane/Clay cover systems would meet the requirements of a cover at this site. They are all comparable in hydrologic efficiency, and are superior to the cover systems proposed in the FS. The Modified Geomembrane/Clay cover is the most expensive of the cover systems analyzed in this document, followed by the Geomembrane/GCL, both of which are composite systems. The Modified Geomembrane/Clay cover was eliminated from consideration due to its higher costs. The Geomembrane cover, is the least expensive, and is the only single barrier system under consideration. The final cover selection would need to be made by the regulators, based on whether the slightly better performance and additional confidence derived from the composite Geomembrane/GCL would offset the cost of the more economical Geomembrane Cover.

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COMPARATIVE ANALYSIS
HIMCO DUMP SUPERFUND SITE
CLAY ALTERNATIVE (10-7)

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4640 VOL/VOL
FIELD CAPACITY	=	0.3104 VOL/VOL
WILTING POINT	=	0.1875 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3104 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000192000007 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4530 VOL/VOL
FIELD CAPACITY	=	0.1901 VOL/VOL
WILTING POINT	=	0.0848 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1901 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000720000011 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0450 VOL/VOL

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.47	1.90	3.22	4.15	2.49	4.26
	4.02	3.89	3.55	3.63	2.89	2.55
STD. DEVIATIONS	1.41	1.08	1.31	1.20	0.88	1.94
	2.18	2.03	1.16	1.93	1.10	1.24
RUNOFF						
TOTALS	0.106	0.321	0.449	0.339	0.000	0.014
	0.042	0.022	0.001	0.045	0.005	0.034
STD. DEVIATIONS	0.299	0.694	0.927	0.698	0.001	0.024
	0.162	0.058	0.004	0.100	0.021	0.134
EVAPOTRANSPIRATION						
TOTALS	0.622	1.034	2.334	3.520	3.024	4.694
	4.866	3.601	3.571	1.993	1.097	0.704
STD. DEVIATIONS	0.133	0.263	0.386	0.623	0.952	1.116
	1.791	1.532	0.655	0.404	0.201	0.119
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	0.5078	0.4947	0.5471	0.5369	0.5485	0.5115
	0.4624	0.3669	0.2263	0.1842	0.2724	0.3982
STD. DEVIATIONS	0.1267	0.0504	0.0422	0.0319	0.0649	0.0932
	0.1091	0.1202	0.1077	0.1283	0.2118	0.1888
PERCOLATION FROM LAYER 4						
TOTALS	0.1474	0.1459	0.1638	0.1576	0.1535	0.1377
	0.1268	0.1130	0.1029	0.1030	0.1031	0.1261
STD. DEVIATIONS	0.0276	0.0287	0.0314	0.0238	0.0187	0.0147
	0.0119	0.0198	0.0244	0.0280	0.0409	0.0348

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'ERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	39.03	(4.424)	4102379.	100.00

SNOW WATER 0.00

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WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0454 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.009999999776 CM/SEC
SLOPE	=	4.00 PERCENT
)RAINAGE LENGTH	=	400.0 FEET

LAYER 4

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC
LINER LEAKAGE FRACTION	=	0.00100000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	76.00
TOTAL AREA OF COVER	=	1261284. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES
UPPER LIMIT VEG. STORAGE	=	9.0540 INCHES
INITIAL VEG. STORAGE	=	5.6440 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	14.7360 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR FORT WAYNE INDIANA

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	125
END OF GROWING SEASON (JULIAN DATE)	=	286

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

AN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.20	26.40	36.00	48.50	59.10	68.80
72.50	70.90	64.20	53.20	40.30	29.10

PRECIPITATION	39.03	(4.424)	4102379.	100.00
RUNOFF	1.802	(2.386)	189448.	4.62
EVAPOTRANSPIRATION	31.667	(3.154)	3328405.	81.13
LATERAL DRAINAGE FROM LAYER 3	5.5833	(0.7091)	586849.	14.31
PERCOLATION FROM LAYER 4	0.0017	(0.0002)	177.	0.00
CHANGE IN WATER STORAGE	-0.024	(2.513)	-2501.	-0.06

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	2.53	265920.7
RUNOFF	1.634	171749.6
LATERAL DRAINAGE FROM LAYER 3	0.0191	2009.1
PERCOLATION FROM LAYER 4	0.0000	0.7
HEAD ON LAYER 4	24.2	
SNOW WATER	2.65	278982.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4527

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1084

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.07	0.1784
2	3.23	0.2692
3	2.53	0.4218
4	10.32	0.4300

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COMPARATIVE ANALYSIS
HIMCO DUMP SUPERFUND SITE
GEOMEMBRANE ALTERNATIVE

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****

FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4640 VOL/VOL
FIELD CAPACITY	=	0.3104 VOL/VOL
WILTING POINT	=	0.1875 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3104 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000192000007 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4530 VOL/VOL
FIELD CAPACITY	=	0.1901 VOL/VOL
WILTING POINT	=	0.0848 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1901 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000720000011 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	0.60 INCHES
POROSITY	=	0.9000 VOL/VOL
FIELD CAPACITY	=	0.0500 VOL/VOL

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.47	1.90	3.22	4.15	2.49	4.26
	4.02	3.89	3.55	3.63	2.89	2.55
STD. DEVIATIONS	1.41	1.08	1.31	1.20	0.88	1.94
	2.18	2.03	1.16	1.93	1.10	1.24
RUNOFF						
TOTALS	0.019	0.006	0.003	0.014	0.000	0.010
	0.035	0.022	0.001	0.044	0.004	0.003
STD. DEVIATIONS	0.069	0.027	0.008	0.037	0.000	0.018
	0.133	0.058	0.004	0.099	0.017	0.013
EVAPOTRANSPIRATION						
TOTALS	0.623	1.032	2.334	3.544	3.007	4.501
	4.137	3.451	3.571	2.011	1.103	0.706
STD. DEVIATIONS	0.134	0.259	0.387	0.637	0.931	1.263
	1.707	1.389	0.648	0.414	0.206	0.120
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	1.7057	1.2073	1.4827	1.1555	0.3662	0.1482
	0.1477	0.0275	0.0222	0.4782	0.8359	1.2692
STD. DEVIATIONS	1.1743	0.9301	1.0744	0.9050	0.3044	0.1818
	0.3071	0.0274	0.0293	0.7579	0.9720	0.8816
PERCOLATION FROM LAYER 4						
TOTALS	0.0074	0.0069	0.0076	0.0073	0.0076	0.0073
	0.0076	0.0074	0.0067	0.0066	0.0067	0.0072
STD. DEVIATIONS	0.0005	0.0001	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0002	0.0005	0.0007	0.0009	0.0008

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT

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COMPARATIVE ANALYSIS
HIMCO DUMP SUPERFUND SITE
GEOMEMBRANE/GCL ALTERNATIVE

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4640 VOL/VOL
FIELD CAPACITY	=	0.3104 VOL/VOL
WILTING POINT	=	0.1875 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3104 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000192000007 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4530 VOL/VOL
FIELD CAPACITY	=	0.1901 VOL/VOL
WILTING POINT	=	0.0848 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1901 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000720000011 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	0.60 INCHES
POROSITY	=	0.9000 VOL/VOL
FIELD CAPACITY	=	0.0500 VOL/VOL

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.47	1.90	3.22	4.15	2.49	4.26
	4.02	3.89	3.55	3.63	2.89	2.55
STD. DEVIATIONS	1.41	1.08	1.31	1.20	0.88	1.94
	2.18	2.03	1.16	1.93	1.10	1.24
RUNOFF						
TOTALS	0.019	0.006	0.003	0.014	0.000	0.010
	0.035	0.022	0.001	0.044	0.004	0.003
STD. DEVIATIONS	0.069	0.027	0.008	0.037	0.000	0.018
	0.133	0.058	0.004	0.099	0.017	0.013
EVAPOTRANSPIRATION						
TOTALS	0.623	1.032	2.334	3.544	3.007	4.501
	4.137	3.451	3.571	2.011	1.103	0.706
STD. DEVIATIONS	0.134	0.259	0.387	0.637	0.931	1.263
	1.707	1.389	0.648	0.414	0.206	0.120
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	1.7132	1.2142	1.4903	1.1629	0.3738	0.1556
	0.1553	0.0349	0.0289	0.4848	0.8425	1.2763
STD. DEVIATIONS	1.1744	0.9301	1.0744	0.9050	0.3043	0.1817
	0.3071	0.0275	0.0295	0.7582	0.9725	0.8820
PERCOLATION FROM LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

****

/ERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT

SNOW WATER 0.00

****
****

WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0454 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.009999999776 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	400.0 FEET

LAYER 4

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC
LINER LEAKAGE FRACTION	=	0.00100000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	76.00
TOTAL AREA OF COVER	=	1261284. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES
UPPER LIMIT VEG. STORAGE	=	9.1260 INCHES
INITIAL VEG. STORAGE	=	4.9359 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	18.9750 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR FORT WAYNE INDIANA

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	125
END OF GROWING SEASON (JULIAN DATE)	=	286

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.20	26.40	36.00	48.50	59.10	68.80
72.50	70.90	64.20	53.20	40.30	29.10

PRECIPITATION	39.03	(4.424)	4102379.	100.00
RUNOFF	0.163	(0.178)	17148.	0.42
EVAPOTRANSPIRATION	30.021	(2.919)	3155423.	76.92
LATERAL DRAINAGE FROM LAYER 3	8.8654	(2.9994)	931814.	22.71
PERCOLATION FROM LAYER 4	0.0016	(0.0002)	173.	0.00
CHANGE IN WATER STORAGE	-0.021	(2.529)	-2180.	-0.05

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	2.53	265920.7
RUNOFF	0.547	57466.6
LATERAL DRAINAGE FROM LAYER 3	0.0659	6922.6
PERCOLATION FROM LAYER 4	0.0000	0.8
HEAD ON LAYER 4	29.9	
SNOW WATER	2.66	279059.9

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3532

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1149

****

****

FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.07	0.1784
2	5.81	0.1938
3	4.37	0.1820
4	10.32	0.4300

APPENDIX B

COST ESTIMATE SUMMARIES

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

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MARTY AMSLER; PHONE # (800)-323-3820.

III. BUDGETARY COST FIGURES FURNISHED BY NATIONAL SEAL COMPANY.

A. GEOTEXTILE
1. 6 OZ. @ .06 / SF (MATERIAL ONLY)
2. 8 OZ. @ .08 / SF (MATERIAL ONLY)
3.10 OZ. @ .10 / SF (MATERIAL ONLY)
4. LABOR @ .05 - .07 / SF

B. GEONET
1. CAPNET @ .11 - .12 / SF (MATERIAL ONLY)
2. PM2000 @ .11 - .12 / SF (MATERIAL ONLY)
3. PM3000 @ .14 / SF (MATERIAL ONLY)
4. LABOR @ .07 - .10 / SF

C. GEOMEBRANE
1. 40 MIL @ .15 / SF (MATERIAL ONLY)
2. 60 MIL @ .23 / SF (MATERIAL ONLY)
3. LABOR @ .19 / SF

D. GEOSYNTHETIC CLAY LINER (GCL)
1. MATERIAL @ .50 / SF
2. LABOR @ .08 - .11 / SF

B. SUGGESTION: A POTENTIAL SAVINGS OF $4.00/CY COULD BE REALIZED, IF THE BUFFER LAYER COULD BE OBTAINED ON-SITE. WETLAND MITIGATION SITES COULD ALSO BE CREATED AT THE BORROW AREAS.

F.3

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
AA GEOMEMBRANE (SECT. 3)									
AA BA 6" TOPSOIL	48400.50	CY	378,131	37,813	8,319	33,941	4,582	462,786	9.56
AA CA 18" SELECT FILL	145200.00	CY	769,937	76,994	16,939	69,110	9,330	942,308	6.49
AA DA GEOTEXTILE	290400.00	SY	451,629	45,163	9,936	40,538	5,473	552,739	1.90
AA EA GEONET	290400.00	SY	660,866	66,087	14,539	59,319	8,008	808,819	2.79
AA FA GEOMEMBRANE	290400.00	SY	1,211,941	121,194	26,663	108,784	14,686	1,483,268	5.11
TOTAL GEOMEMBRANE (SECT. 3)	60.00	ACR	3,472,505	347,250	76,395	311,692	42,078	4,249,921	70832.01
BA GEOMEMBRANE/GCL (SECT. 4)									
BA BA 6" TOPSOIL	48400.50	CY	378,131	37,813	8,319	33,941	4,582	462,786	9.56
BA CA 18" SELECT FILL	145200.00	CY	769,937	76,994	16,939	69,110	9,330	942,308	6.49
BA DA GEOTEXTILE	290400.00	SY	451,629	45,163	9,936	40,538	5,473	552,739	1.90
BA EA GEONET	290400.00	SY	660,866	66,087	14,539	59,319	8,008	808,819	2.79
BA FA GEOMEMBRANE	290400.00	SY	1,211,941	121,194	26,663	108,784	14,686	1,483,268	5.11
BA FB GEOSYNTHETIC CLAY LINER (GCL)	290400.00	SY	1,729,197	172,920	38,042	155,213	20,954	2,116,325	7.29
TOTAL GEOMEMBRANE/GCL (SECT. 4)	60.00	ACR	5,201,701	520,170	114,437	466,905	63,032	6,366,246	106104.09
CA CLAY COVER (SECT. 1)									
CA AA 6" TOPSOIL	48400.50	CY	378,131	37,813	8,319	33,941	4,582	462,786	9.56
CA AB 12" SELECT FILL(PART OF TOPSOIL)	96840.00	CY	513,503	51,350	11,297	46,092	6,222	628,465	6.49
CA AC 6" SAND DRAINAGE LAYER	48420.00	CY	374,783	37,478	8,245	33,641	4,541	458,689	9.47
CA BA 24" CLAY FILL	193602.00	CY	1,026,593	102,659	22,585	92,147	12,440	1,256,424	6.49
TOTAL CLAY COVER (SECT. 1)	60.00	ACR	2,293,011	229,301	50,446	205,821	27,786	2,806,364	46772.74
DA GEOMEMBRANE/CLAY (SECT. 2)									
DA AA 6" TOPSOIL	48400.50	CY	378,131	37,813	8,319	33,941	4,582	462,786	9.56
DA AB 12" SELECT FILL(PART OF TOPSOIL)	96840.00	CY	513,503	51,350	11,297	46,092	6,222	628,465	6.49
DA AD 6" SAND DRAINAGE LAYER	48420.00	CY	374,783	37,478	8,245	33,641	4,541	458,689	9.47
DA AE GEOMEMBRANE (40 MIL.)	290400.00	SY	1,211,941	121,194	26,663	108,784	14,686	1,483,268	5.11
DA BA 24" CLAY FILL	193602.00	CY	1,026,593	102,659	22,585	92,147	12,440	1,256,424	6.49
TOTAL GEOMEMBRANE/CLAY (SECT. 2)	60.00	ACR	3,504,952	350,495	77,109	314,604	42,472	4,289,632	71493.87
EA MODIFIED GEOMEM./CLAY (SECT. 5)									
EA AA 6" TOPSOIL	48400.50	CY	378,131	37,813	8,319	33,941	4,582	462,786	9.56
EA BA 30" SELECT FILL	242040.00	CY	1,283,440	128,344	28,236	115,202	15,552	1,570,774	6.49
EA CA GEOTEXTILE	290400.00	SY	451,629	45,163	9,936	40,538	5,473	552,739	1.90
EA DA 24" SAND DRAINAGE LAYER	193620.00	CY	1,498,669	149,867	32,971	134,521	18,160	1,834,187	9.47
EA EA GEOMEMBRANE (40 MIL.)	290400.00	SY	1,211,941	121,194	26,663	108,784	14,686	1,483,268	5.11
EA FA 24" CLAY FILL	193602.00	CY	1,026,593	102,659	22,585	92,147	12,440	1,256,424	6.49
TOTAL MODIFIED GEOMEM./CLAY (SECT. 5)	60.00	ACR	5,850,404	585,040	128,709	525,132	70,893	7,160,178	119336.30

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APPENDIX G

REMEDIAL ACTION
HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX G
ENVIRONMENTAL DESIGN CALCULATIONS

TABLE 1

HIMCO DUMP SITE, ELKHART, INDIANA
VOCs DETECTED IN MASS GAS SAMPLES DURING REMEDIAL INVESTIGATIONS, PHASE I (OCT.90-FEB.91) AND THEIR CALCULATED EMISSION RATES

Maximum Concentrations of VOCs Detected in Mass Gas Samples	Max.conc. Detected (ng/l)	Max.conc. Detected (mg/l)	Max. Conc. Detected (mg/m3)	Molecular Weight (g/mole)	Max. Conc. Detected (ppm by vol.**)	Boiling Point* (deg C)	Boiling Point* (deg F)	Conc. (lbs/FT3)	VOCs*** lbs/day
Methyl chloride	1100	0.00110	1.10000	50.49	0.53377	-24.0	-11.2	6.9E-08	0.109
Vinyl Chloride	8600	0.00860	8.60000	62.50	3.37120	-13.9	7.0	5.4E-07	0.850
Methylene Chloride	80	0.00008	0.08000	84.93	0.02308	40.2	104.4	5E-09	0.008
Acetone	26	0.00003	0.02600	58.08	0.01097	56.5	133.7	1.6E-09	0.003
Carbon Disulfide	300	0.00030	0.30000	76.14	0.09653	46.3	115.3	1.9E-08	0.030
1,1-Dichloroethylene	86	0.00009	0.08600	96.94	0.02174	37.0	98.6	5.4E-09	0.009
1,1-Dichloroethane	150	0.00015	0.15000	98.96	0.03714	57.3	135.1	9.4E-09	0.015
1,2-Dichloroethene-Total	1300	0.00130	1.30000					8.1E-08	0.128
1,1,1-Trichloroethane	300	0.00030	0.30000	133.41	0.05509	74.0	165.2	1.9E-08	0.030
Trichloroethene	370	0.00037	0.37000	131.39	0.06899	87.2	189.0	2.3E-08	0.037
Benzene	140	0.00014	0.14000	78.11	0.04391	80.1	176.2	8.7E-09	0.014
Tetrachloroethene	1400	0.00140	1.40000	165.83	0.20684	121.2	250.2	8.7E-08	0.138
Toluene	600	0.00060	0.60000	92.14	0.15954	110.6	231.1	3.7E-08	0.059
Ethyl Benzene	700	0.00070	0.70000	106.17	0.16153	136.2	277.2	4.4E-08	0.069
Styrene	10	0.00001	0.01000	104.15	0.00235	145.2	293.4	6.2E-10	0.001
Xylenes	1300	0.00130	1.30000	106.17	0.29999	139.1	282.4	8.1E-08	0.128
Total								1E-06	1.62713

594 lbs/yr

or 0.30 ton/yr

Use a safety factor of 2, then Total VOCs emitted per year 0.59 ton/yr

or 3.25 lbs/day

* From Lange's Handbook of Chemistry,1967; Physical Constans of Organic Compounds
Boiling Points are given at atmospheric pressure, 1 Atm, (760 mm of Mercury)

** ppm @ 25degC (77deg F) and 1 atm

*** Flow rate= 1,100 cfm.

NOTES:

Flow Rate= 1,100 cfm

1 cubic meter = 1,000 liters

1 ng/l = 1x10^-6 mg/l

ppm by volume = (conc (mg/m3)x24.5)/molecular weight

PROJECT HIMCO DUMP SF SITE, ELKHART, IN		SHEET NO. 1	OF 6
ITEM SIZING CARBON ADSORPTION UNITS		BY OMN	DATE 3/25/98
		CHKD. BY	DATE

A. LIQUID-PHASE GAC UNITS

Condensate flow = 600 gpd (estimated by Mechanical Engr.)

$$Flow = 600 \frac{gal}{d} \times \frac{d}{1440\ min}$$

$$Q_{Cond} = 0.42\ gpm$$

* Concentration of VOCs in the condensate is not known. Condensate may include VOCs in the off-gas. Refer to Enclosure 2 for VOCs found in soil gas during a mass gas samling event during Phase I Remedial Investigation activities conducted Oct. 90 - Feb. 91. The enclosure indicates the maximum concentrations detected during sampling of 14 "waste mass gas samples."
* A rough estimate of VOCs concentration in the condensate was made (refer to Enclosure 4). A very conservative VOC concentration of 0.68 mg/L was estimated. Although this number is based on several assumptions (see Enclosure 4) due to uncertainties.

* Use a low-flow (10-gpm) GAC unit. Required contact time (per Mfgr.) is 8-10 min. This contact time can be maintained at a flow rate of 5 gpm (per Carbon Mfgr.) which is significantly higher

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT		SHEET NO. 2	OF 6
ITEM		BY OMN	DATE 3/25/98
		CHKD. BY	DATE

than estimated condensate flow rate of 0.42 gpm. A 10-gpm liquid-phase GAC unit should be adequate. However, the Contractor will assume that adequate space is available in case bigger units would be needed based on findings during O&M period.

* Use 2 10-gpm LGAC units in series (lead & lag units).

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★ U.S. GOVERNMENT PRINTING OFFICE: 1996-757-246

B. VAPOR-PHASE GAC UNITS.

* Off gas flow rate = 1,100 cfm (estimated by Mechanical Engineer)

* Flow Rate per GAC unit = 275 cfm (total of 4 units)
  Have 2 units in parallel after each blower.
  Have a heat exchanger before each parallel units to lower off gas temperature to 135 °F or below.

* Relative humidity of influent off gas < 50 % ← Assumption
* Minimum influent off gas temperature will be the temperature at which the R.H. of 50 % is reached.
* CALGON's computer program estimated a Carbon usage rate based on treatment of Methyl Chloride & Vinyl Chloride ≅ 2,500 lbs/d. Very cost prohibitive!

  If methyl chloride & Vinyl Chloride are allowed to breakthrough, then the rate drops to approximately 825 lbs C/day. Still very high usage.
  These rates were determined by a CALGON computer model assuming temp. = 110 °F & R.H. < 50 % and w/ VOCs concentrations given in the attached table.

* There will not be any back-up units and the units will be periodically monitored (as defined in the O&M manual) to replace the carbon at breakthrough.

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO, ELKHART, IN		SHEET NO. 4	OF 6
ITEM SIZING GAC UNITS (Cont'd)		BY OMN	DATE 12/26/95
		CHKD. BY	DATE

* INFO. FROM CARBONAIR Environmental Systems, Inc.:

Using 5,000 lbs of 8x30 mesh reactivated carbon per vessel At 550 cfm and 135°F, 2 GPC-48 units in series would last 71 days, but methyl chloride, vinyl chloride, methylene chloride, acetone, carbon disulfide, and 1,1-DCE would not be effectively removed & would pass through the carbon. Carbon usage rate would be approximately 280 lb/d for the entire system (Flow = 1,100 cfm)

Assumptions → Temp. = 135 °F

R.H. = 50%

Flow Rate = 550 cfm

See the attached info. from CARBONAIR.

* Based on relatively high Carbon usage rates and relatively low VOCs concentrations in the off gas, it was decided that the landfill off gas treatment system will be designed to primarily remove H_2S from the off gas. In addition, based on the data available, Total VOCs/yr is 594 lbs/yr or 0.3 ton/yr. Using a Safety Factor of 2,

Total VOCs/yr = (2)(0.3 ton/yr) = 0.6 ton/yr [< 25 tons State Criteria] OK

Total VOCs/day = 3.3 lbs/day [< 15 lbs/day State Criteria]

OK

MRO Form 1550, 1 DEC 83

State of Indiana does not have any effluent limits on specific VOCs (telephone conversation w/ Don Poole, Air Management, on 11/29/95). However, it has the following limits on total VOCs:

$$VOC_{Tot} = 15 \text{ lbs/d}$$

or

$$VOC_{Tot} = 25 \text{ tons emitted/yr.}$$

Mr. Poole indicated that no application would need to be made if the facility was below the criteria given above w/ regards to VOC_{tot} emissions into the air.

* CALGON indicated (telephone conversation w/ Karl Krause from Calgon Corp., (~~708~~ 630) 505-1919, on 5/22/96) that no carbon usage rate estimation could be made for H_2S removal primarily due to the following:
  - Influent H_2S concentration in the landfill off gas is not known and
  - VOCs in the off gas will interfere w/ H_2S removal.

Therefore, the Contractor will perform a pilot test prior to installation of the Vapor-phase Granular Activated Carbon (VGAC) units to determine actual carbon usage to size the VGAC units. This will be done by

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO, Elkhart, IN		SHEET NO. 6	OF 6
ITEM SIZING GAC UNITS (Cont'd)		BY OMN	DATE 5/24/96
		CHKD. BY	DATE

using a 55-gallon VGAC units and a 100 cfm off gas flow rate and the pilot test will continue until the H_2S breakthrough is reached which will be determined upon detection by a H_2S monitoring equipment. The effluent H_2S concentration will also be at levels recommended by the flare manufacturer for protection of the flare system from corrosion.

* H_2S is removed after being converted to carbon disulfide upon adsorption onto C.

* There is practically no O&M requirements for VGAC units. Refer to the attached info. from CALGON for more info.

MRO Form 1550, 1 DEC 83

☆U.S.G.P.O.: 1995-657-136

CEMRO-OC (200) 16 November 1992

MEMORANDUM FOR CEMRO-ED-MB (SHARON J. LYBARGER)

SUBJECT: Recent NPDES Storm Water Discharge Permit Regulations

1. Your Office recently asked Office of Counsel to review several issues which have arisen in connection with Omaha District's compliance with the subject regulations and the District's implementation of the Corps NPDES policy. We previously responded to three of your four questions by Memorandum dated 14 September 1992. You also posed the general question of whether an NPDES permit pursuant to the Clean Water Act would be required for work on an NPL site.

2. The Clean Water Act generally provides that "the discharge of any pollutant by any person shall be unlawful" except as in compliance with the Act. 33 U.S.C.S. Section 1311(a). The term "discharge of any pollutant" means "any addition of any pollutant to navigable waters from any point source. . . ." 33 U.S.C.S. Section 1362(12). The Act therefore requires that permits to discharge be obtained, including permits for storm water discharges, unless an exception applies. Generally speaking, then, the Corps of Engineers is obligated to obtain permits for its discharges unless an exception exists.

3. To answer the question whether NPDES permits or other permits must be acquired for work on an NPL site, one must look to the appropriate sections of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, or more commonly "Superfund"), 42 U.S.C.S. Section 9601, <u>et seq</u>. Subsection 9621(e)(1) of the Cleanup Standards section states: "No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely on site, where such remedial action is selected and carried out in compliance with this section." The key, therefore, is that permits are not required provided that Section 9621 as a whole is followed. Section 9621 consists of six subsections: (a) Selection of remedial action; (b) General rules; (c) Review; (d) Degree of cleanup; (e) Permits and enforcement; and (f) State involvement. Subsection 9621(a) also clarifies that "[t]he President shall select appropriate remedial actions determined to be necessary to be carried out under Section 104 [42 U.S.C.S. Section 9604] or secured under Section 106 [42 U.S.C.S. Section 9606] which are in accordance with this section and, to the extent practicable, the National Contingency Plan, and which provide for cost-effective response." Implementing regulations concerning permits are found in the Code of Federal Regulations. 40 C.F.R. Section 300.400(e) expresses EPA regulations concerning permit requirements as follows:

CENRO-OC
SUBJECT: Recent NPDES Storm Water Discharge Permit Regulations

(1) No federal, state, or local permits are required for on-site response actions conducted pursuant to CERCLA Sections 104, 106, 120, 121, or 122. The term on-site means the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action.

(2) Permits, if required, shall be obtained for all response activities conducted off-site.

40 C.F.R. Section 300.700(c)(5) goes on to clarify that the "following provisions of this part are potentially applicable to private party response actions: . . . (iii) . . .; (e) (on permit requirements) except that the permit waiver does not apply to private party response actions; . . .." (Emphasis added.) However, the permit waiver is interpreted to apply to "federal facility cleanups conducted pursuant to CERCLA section 120(e), which are also selected and carried out in compliance with CERCLA section 121 [see CERCLA section 120(a)(2)]". 55 Fed. Reg. 8689 (1990). This regulatory interpretation tracks relevant language found on page 242 of the House Conference Report No. 99-962 regarding SARA which states ". . .CERCLA, together with RCRA, requires Federal facilities to comply with all Federal, State and local requirements, procedural and substantive, including fees and penalties, except as provided in section 121." 1986 U.S. Code Cong. & Ad. News 3335. Therefore, although the Department of Defense must comply with CERCLA "in the same manner and to the same extent, both procedurally and substantively, as any nongovernmental entity," 42 U.S.C.S. Section 9620(a), the Department of Defense is not considered to be a "private party" for purposes of the permit waiver. See, State of Colorado v. United States Department of the Army, 707 F. Supp. 1562, 1568 (D. Colo. 1989) (Subsection 9621(e)(1) exempts CERCLA sites from "having to acquire state or federal permits for remedial action conducted on site".

4. Does the permit waiver for federal actions apply on any "site" or only on "NPL sites"? The regulations clearly state that no permits are required "for on-site response actions conducted pursuant to CERCLA Sections 104, 106, 120, 121 or 122". 40 C.F.R. Section 300.400(e). There is no explicit requirement that the site in question be included on the National Priorities List. At least one federal court has held that "NPL listing is not a general requirement under the NCP". State of New York v. Shore Realty Corp., 759 F.2d 1032, 1046 (2nd Cir. 1985). "Congress did not intend listing on the NPL to be a requisite to all response actions." Id. at 1047.

CEMRO-OC
SUBJECT: Recent NPDES Storm Water Discharge Permit Regulations

5. Therefore, from a reading of the law it appears that a permit is unnecessary for a response action provided that:

(1) The action is conducted pursuant to CERCLA sections 120 and 121;

(2) The National Contingency Plan is followed;

(3) The action is cost-effective; and

(4) The action will be conducted entirely on site.

Note the concern, however, that NPDES-type discharges may, under a specific factual scenario, be made to receiving waters outside the "site", and that therefore it may be a reasonable interpretation that the remedial action is not being carried out "entirely on site". This is a hypothetical situation, to be sure, but it may arise under a given set of facts, and for this reason care should be taken to examine the necessity for any permits, including NPDES permits, on a site-specific basis, rather than rigorously relying on a general information memorandum of this type.

6. If you have any comments or questions, please contact the undersigned at extension 4058. Thank you.

Stanley E. Tracey

STANLEY E. TRACEY
Assistant District Counsel

4.5.2.3 Semi-Volatile Organic Compounds (SVOCs)

SVOC ranges found in sediment samples are summarized in Table 4-26, which indicates that four SVOCs were detected above detection limits. The concentration of SVOCs by sample location is presented in Figure 4-23. SVOCs were detected at random locations and at consistently low concentrations (less than 220 ug/kg). Therefore, the impact of site-related SVOCs on the sediment at the site is minimal.

4.5.2.4 Pesticides/PCBs

Pesticides or PCBs were not detected in any sediment sample collected during the RI.

4.6 WASTE MASS GAS

Fourteen waste mass gas samples were collected during Phase I RI activities and analyzed for VOCs. Sampling procedures are described in Section 2.4. The waste mass gas samples were analyzed for VOCs.

VOC concentration ranges found in waste mass gas samples are summarized in Table 4-27. Table 4-27 also summarizes the number of waste mass gas sample locations, and the number of samples in which each VOC was detected.

Sixteen VOCs were detected in the 14 waste mass gas samples collected. The VOCs detected were (maximum concentration detected in parentheses): chloromethane (1,100 ng/l), vinyl chloride (8,600 ng/l), methylene chloride (80 ng/l), acetone (26 ng/l), carbon disulfide (300 ng/l), 1,1-dichloroethene (86 ng/l), 1,1-dichloroethane (150 ng/L), 1,2-dichloroethene (total) 1,300 ng/l), 1,1,1-trichloroethane (300 ng/l), trichloroethene (370 ng/l), benzene (140 ng/l), tetrachloroethene (1,400 ng/l), toluene (600 ng/l), ethyl benzene (700 ng/l), styrene (10 ng/l), and xylenes (total) (1,300 ng/l).

Figure 4-24 presents the locations of the waste mass gas samples along with the total VOC concentrations at each sample location. This figure shows that total VOCs were detected in all samples collected. However, the concentration of total VOCs was less than 1 ug/l in 12 of the 14 samples.

Waste mass gas sample TT-05 contained 9,766 ng/l total VOCs. The main contributors to this total VOC concentration were vinyl chloride (4,000 ng/l), total 1,2-dichloroethene (1,300 ng/l), total xylenes (1,300 ng/l), and chloromethane (1,100 ng/l).

Encl. 2

SERVICE BULLETIN

VAPOR PAC

CALGON

Calgon Carbon's Vapor Pac Service meets industrial needs for cost-effective removal of volatile organic compounds (VOCs) at air emission sources.

The Vapor Pac Service features a small, easily transportable adsorber which contains 1,800 pounds of activated carbon. The adsorber can handle air flows up to 1,000 cfm.

Designed to remove both toxic and non-toxic VOCs, the adsorption system is especially useful for short-term projects and for treatment of low volume flows that contain low to moderate VOC concentrations. Common applications include VOC removal from process vents, soil remediation vents, and air stripper off-gases.

To accommodate a wide variety of process conditions, Vapor Pac adsorbers are available in two basic designs: a polyethylene model that offers excellent corrosion-resistance, and a stainless steel model than can withstand higher temperatures, and slight pressure or vacuum conditions.

Calgon Carbon provides the adsorber, carbon, spent carbon handling and carbon reactivation (after the carbon meets the company's acceptance criteria) as part of the Vapor Pac Service. Ductwork and fans are the only equipment requiring a capital expenditure by the user.

When carbon becomes saturated with VOCs, the system is replaced with another adsorber containing fresh carbon.

By utilizing this unique service, users can generally achieve VOC removal and regulatory compliance objectives, minimize operating costs, and eliminate maintenance costs* (as the equipment is owned and maintained by Calgon Carbon). Furthermore, because organic compounds are safely destroyed through the carbon reactivation process, costs and regulations typically associated with waste disposal can be eliminated.

Please contact a Calgon Carbon Technical Sales Representative to learn more about the advantages of the Vapor Pac Service for your specific VOC control needs.

**Damage to Vapor Pac Unit caused by negligence or misapplication is the responsibility of the user.*

FEATURES AND BENEFITS OF VAPOR PAC SERVICE

- Adsorbers are specifically designed for ease of installation and operation.
- Adsorbers are available in plastic (polyethylene) and metal (stainless steel) construction to accommodate a wide variety of applications.
- System can be operated in series or parallel mode or a combination of both modes to handle a variety of flows and concentrations.
- System exchange eliminates on-site carbon handling.
- Recycling of spent carbon eliminates disposal problems.
- Capital expenditure is eliminated since Calgon Carbon Corporation owns and maintains equipment.

VAPOR PAC (PLASTIC) SPECIFICATIONS

Vessel dimensions: .... 44¼" x 44¼" x 89⅜"

Inlet & discharge connections: .... 6" PS 15-69 duct flanges

Carbon volume: .... 60 cu. ft. (1800 lbs)

System shipping weight: .... New - 2200 lbs
Spent - 4000 lbs

Temperature rating: .... 150°F max

Static pressure rating above carbon level: .... 20" W.C. max

Vacuum pressure rating above carbon level: .... 2" W.C. max

All units shipped F.O.B., Pittsburgh, Pennsylvania

MATERIALS OF CONSTRUCTION

Vessel: .... Polyethylene

Frame: .... Carbon steel coated with Sherwin Williams Tile Clad II

Inlet flanges, elbow, septum: .... PVC

Discharge flange: .... Polyethylene

Fasteners & bottom valve support plate: .... Steel, plated

Sample fittings & sample canister: .... PVC

VAPOR PAC (STAINLESS STEEL) SPECIFICATIONS

Vessel dimensions, diameter: .... 5'
height: .... 7'3"

Inlet & discharge connections: .... 8" PS 15-69 duct flanges

Carbon volume: .... 60 cu. ft. approx. (1800 lbs)

System shipping weight: .... New - 2840 lbs
Spent - 4640 lbs

Static pressure rating above carbon level: .... 15 psig

Vacuum pressure rating above carbon level: .... Full

All units shipped F.O.B., Pittsburgh, Pennsylvania

Encl. 3

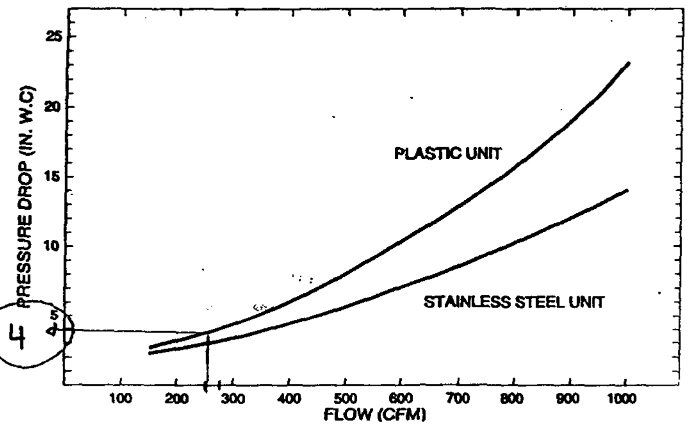
CALGON CARBON CORPORATION • P.O. BOX 717 • PITTSBURGH, PA 15230-0717 • PHONE 1-800-4CARBON

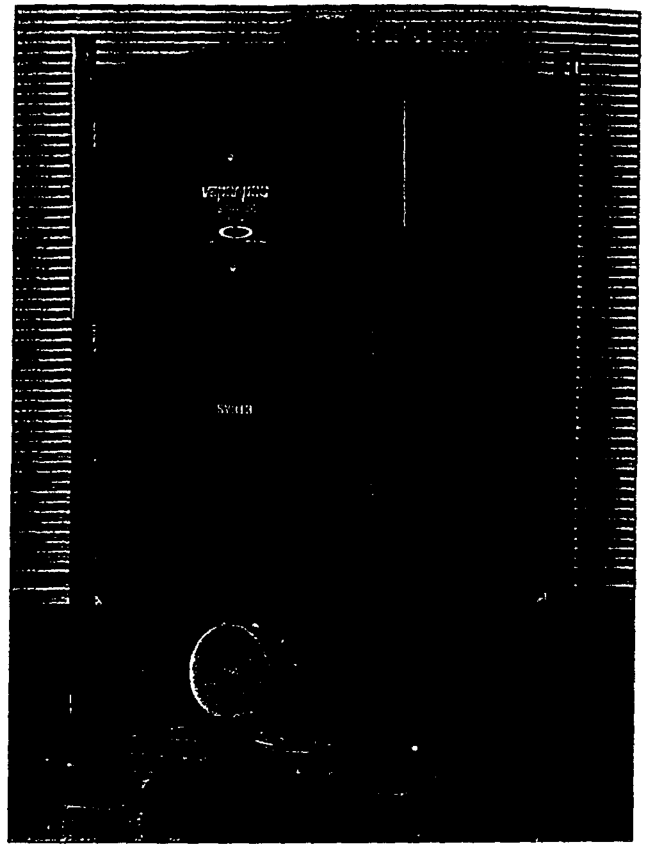
27-173a-06/93

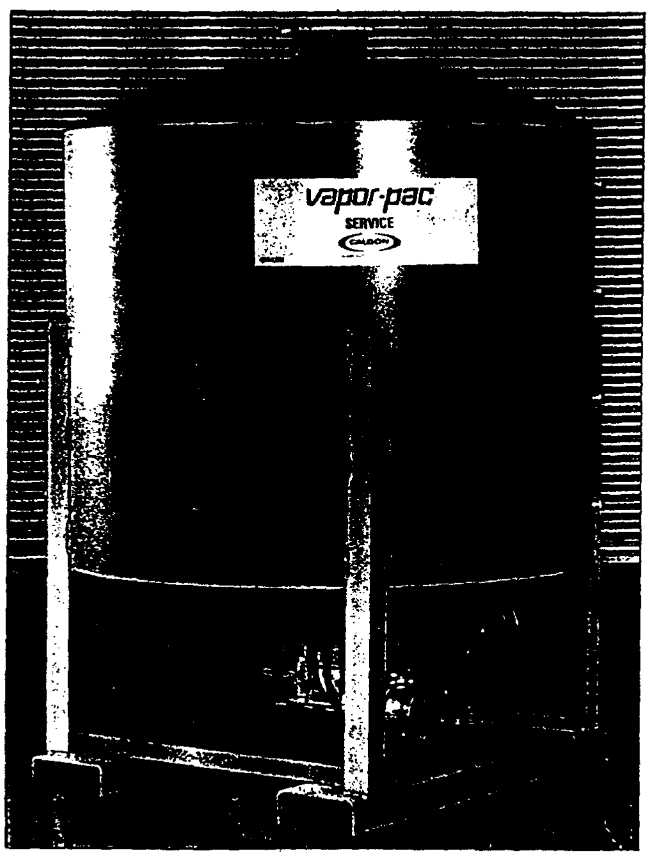
MATERIALS OF CONSTRUCTION

Vessel ....316L stainless steel
Skid and support frame: ....304 stainless steel
Inlet flanges, elbow, septum: ....316L stainless steel
Discharge flange: ....316L stainless steel
Fasteners & bottom valve
    support plate: ....Steel, plated
Sample fittings &
    sample canister: ....316L stainless steel

VAPOR-PAC UNIT PRESSURE DROP
UPFLOW WITH 1800LBS., 4x10 MESH CARBON DENSE PACKED







CAUTION

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing activated carbon, appropriate sampling and work procedures should be followed, including all applicable federal and state requirements.

For information regarding human and environmental exposure, call Calgon Carbon's Regulatory and Trade Affairs personnel at (412) 787-6700.

INSTALLATION INSTRUCTIONS

See Bulletin #27-199 for details on how to install a Vapor-Pac.

SAFETY CONSIDERATIONS

See Safety Bulletin #27-198 for important safety considerations.

OPTIONAL EQUIPMENT

Inlet and outlet flange connectors for ANSI hose connections.

For additional information, contact
Calgon Carbon Corporation,
Box 717, Pittsburgh, PA 15230-0717,
Phone (414) 787-6700

CALGON
CALGON CARBON CORPORATION

VAPOR-PAC SERVICE UNIT INSTALLATION INSTRUCTIONS

CALGON
CALGON CARBON CORPORATION

GENERAL DESCRIPTION

Vapor-Pac Service Units are designed to remove volatile organic compounds from various vapor streams using granular activated carbon adsorption. Each unit contains 1800 lbs of vapor phase granular activated carbon and is capable of handling flows up to 1000 cfm. Vapor-Pacs may be operated in a series or parallel mode.

INSTALLATION INSTRUCTIONS

The Vapor-Pac service unit is shipped ready to install. Examine it to ensure that damages have not occurred in shipment and that all hardware is tight.

Prior to connecting the unit, the bin should be placed on a level accessible area as near as possible to the emission source. If the unit is to be anchored, it is suggested that suitable material (6" channel, 56" in length minimum) be used. This can be either inserted through the fork channel or laid across the base frame. These can then be bolted to the floor.

PLASTIC UNIT

Remove the flange protection covers by hand — **DO NOT CUT**. Loosen the top discharge lid by twisting to one side, then lift out. Inspect the carbon top surface because in transit the carbon bed may have shifted. Level the top surface, if needed, then reinsert the lid and twist it to lock it in place.

The unit is supplied with six-inch PS 15-69 flanges, both inlet and outlet, as standard connections.

METAL UNIT

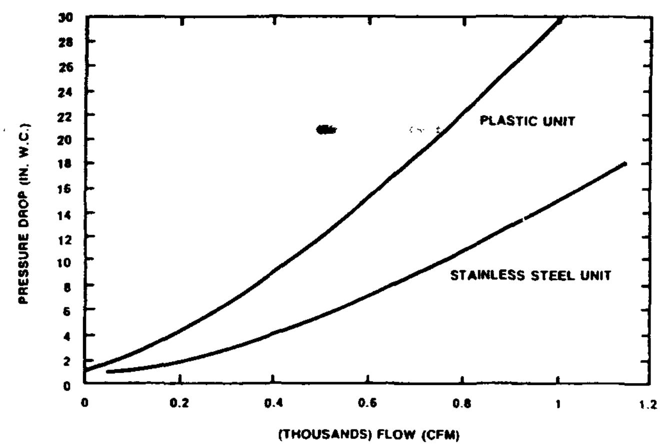
The unit is supplied with both inlet and outlet eight-inch PS 15-69 flanges.

All that is needed for connection to a system is flanged ductwork or flexible ventilating hose. All ductwork to the unit should be self-supporting, eliminating stress on the flanges. Exhaust ducting can be vented directly to the atmosphere with suitable rain shield protection or tied into an existing stack. Optional adapter flanges are available for both systems.

Before starting the unit on-line, ensure that the following specifications are not exceeded:

	PLASTIC	METAL
Temperature rated	150°F max	
Static pressure rated above carbon level	20" max	15" max
Vacuum pressure rated above carbon level	2" max	Full

VAPOR-PAC UNIT PRESSURE DROP
UPFLOW WITH 1800 LBS. 6 x 16 CARBON



- If the inlet is equipped with a sample canister, follow the installation instructions provided with the device.
- After it has been determined that the carbon is spent, disconnect the ductwork and remove the unit from the on-line position. Reinstall the flange protector covers.
- Return shipping instructions should be obtained through your Calgon Carbon sales representative.

SAFETY CONSIDERATIONS

See Safety Bulletin #27-198 for important safety considerations.

For additional information contact Calgon Carbon Corporation, P.O. Box 717, Pittsburgh, PA 15230-0717. Phone Number 412-787-6700.

CALGON
CALGON CARBON CORPORATION

FAX # 402-221-3842

FAX

CALGON

CALGON CARBON CORPORATION

COMMERCIAL GROUP
P.O. BOX 717
PITTSBURGH, PA 15230-0717

PHONE: (412) 787-6700
FAX: (412) 787-6324

TO: Okan Nalbant DATE: 12-19-95

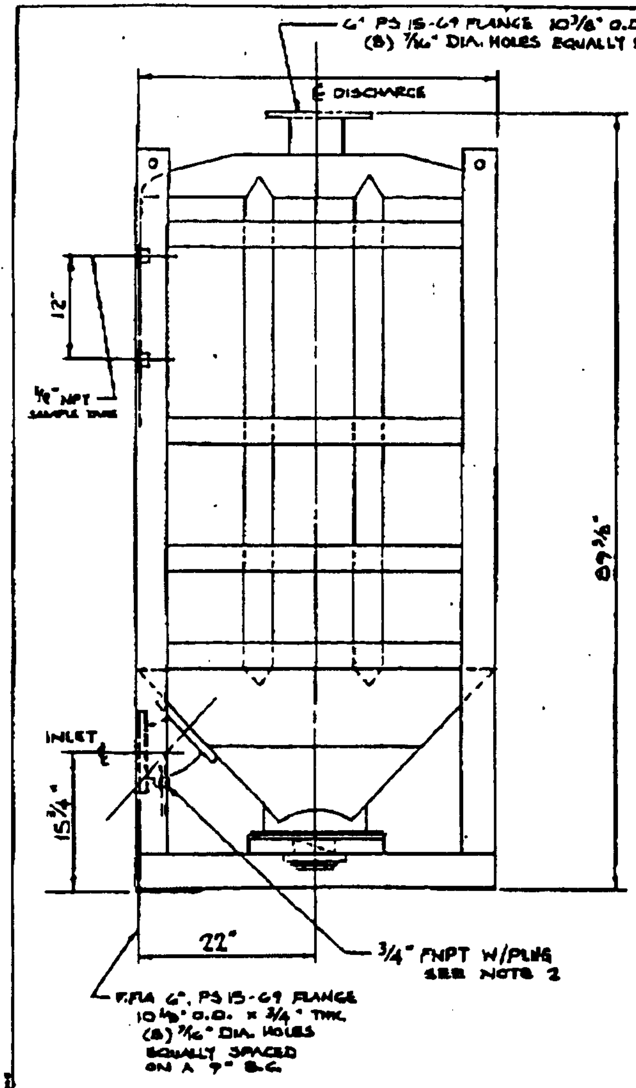
LOCATION\COMPANY: US Army Corps of Engrs.

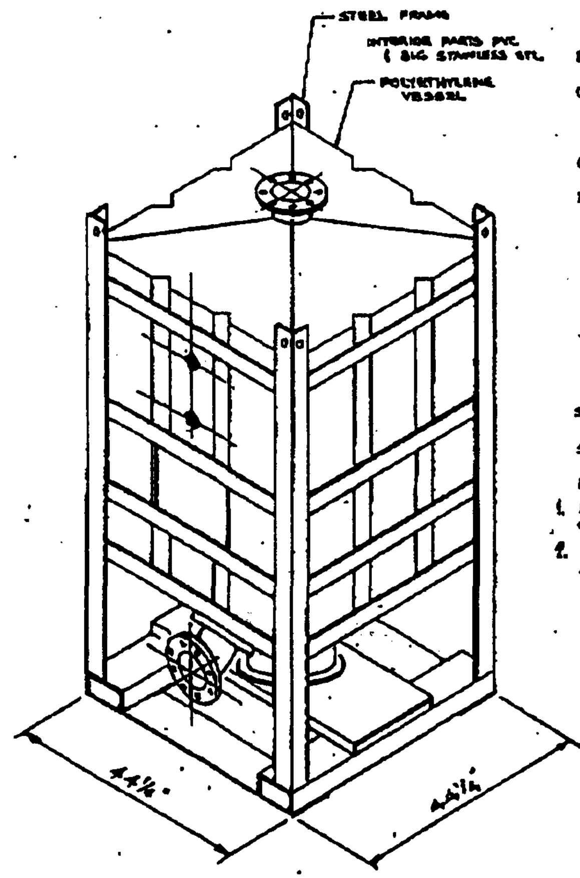
FROM: RICK SAUNDERS

TOTAL NUMBER OF PAGES (INCLUDING COVER): 2
(IF YOU DO NOT RECEIVE ALL PAGES, CALL (412) 787-6756)

SUBJECT\REFERENCE: Vapor Pac Drawing

MESSAGE:





Empty weight: - 400 lbs

Capacity: 70 cu ft

- carbon charge ______________ 1,400 lbs

Cross-section area: 13.4 sq ft

Estimated carbon depth above septa: 50"

Temperature rating (liner): 150°F max.

STATIC VACUUM RATING ABOVE CARBON LEVEL 2" W.G.

STATIC PRESSURE RATING ABOVE CARBON LEVEL 20" W.G.

NOTE:

1. DO NOT SUPPORT CONNECTING DUCTWORK OR EQUIPMENT FROM INLET/OUTLET FLANGES.
2. OPTIONAL SAMPLE CANISTER AVAILABLE FOR CONNECTION TO INLET ELBOW.

NO.	REVISION	BY	DATE
3	MOVED NAME PL	RH	7-11-89
2	RENAME TWISTLOCK LID	DZ	[illegible]
1	AS BUILT REVISION	JS	[illegible]

PLANT 90 · CUSTOMER GENERAL

PROJECT	
SCALE	NONE
DRAWN	RWF
DATE	8-11-87
CHK'D	
APPR'VD	R.S. [illegible]

CALGON

CALGON CARBON CORPORATION
P.O. BOX 717 PITTSBURGH, PA 15230-0717

TITLE: VAPOR-PAC SERVICE UNIT

DWG. NO. 90-87-1646 REV. 3

CARBONAIR ENVIRONMENTAL SYSTEMS, INC
5540 MONTICELLO LANE
MAPLE GROVE, MINNESOTA
55369-4547
612•425•2992 800•526•4999
FAX 612•425•6882

CARBONAIR®
ENVIRONMENTAL SYSTEMS

FAX

Mr. Okan Nalbant
Department of the Army
Corps. of Engineers, Omaha District
215 North 17 th Street
Omaha, NE 68102-4978
Tel: 402-221-4872
Fax: 402-221-3842

Date: December 5, 1995

Dear Okan:
Here is the modeling and information you requested on vapor phase carbon. Sorry for the delay. Below is a description and pricing, literature and model are attached.

Description/Pricing

(2) Carbonair model GPC 48 Vapor Phase carbon vessels $32,500.00

Each Includes: Carbon steel construction with epoxy paint lining inside and out
5,000 lbs of 8x30 mesh reactivated carbon per each vessel
Flow of 1300 cfm
(4) 8" quick connect inlets
16" discharge

Note: At 550 cfm and 135°F, (2) GPC-48 units in series will last 71 days, but chloromethane, vinyl chloride, methylene chloride, acetone, carbon disulfide and 1,1-DCE will not be effectively removed and will pass through the carbon.

In response to your questions in your fax dated 11/15/95:
1. Reactivated or virgin carbon is not effective for removing H2S. An impregnated carbon must be used which will react with the H2S. The carbon cannot be reactivated like other vapor phase carbon. I have included some information on impregnated carbon for H2S removal.
2. The compounds with a low boiling point (methylene chloride, vinyl cloride and DCE) will not be effectively removed
3. Yes, to determine how fast the mass transfer zone moves through the vessels, which will give an accurate time for usage. Although two vessels are not necessary.

General Conditions
1. This proposal is subject to attached terms and conditions.
2. Terms of payment are Net 30 days.
3. Proposal and pricing valid for 30 days from the date of this proposal.
4. This proposal and pricing are based on our interpretation of the sections of the sections of the FRP or specification that have been made available to us. Exceptions have been noted where ever possible. In the event of a conflict between the language in the specification and the proposal, the language in the proposal takes precedence and is the basis of the proposed pricing. Carbonair reserves the right to reject any order based on differences in pricing. Carbonair reserves the right to reject any order based on differences in interpretation of the specification, or for any reason at the time that an order is tendered.
5. Carbonair will not initiate work without a fully executed contract or purchase order. Fabrication will not be initiated until complete submittal approvals have been received.
6. Submittals will be provided within two weeks of receipt of a fully executed contract or purchase order.
7. Equipment can generally be shipped within 6-8 weeks after receipt of completely approved submittals. Lead time will be updated at the time of order execution.
8. Shipping charges are not included in the prices quoted unless explicitly stated in the proposal. Actual freight costs will be pre-paid and added to the invoice.
9. Sales tax is not included in the prices quoted. Where required sales tax will be added to the invoice.

CARBONAIR

If you have any questions or comments concerning this information, please feel free to give me a call at 800-526-4999 or 800-526-4999. Thank you for the opportunity to bid on this project.

Sincerely,

Garth Hoffelt
Regional Manager, Southeast

CARBONAIR Gas Treatment

GPC Series Gas Phase Carbon Adsorbers

GPC gas phase carbon adsorbers are designed to provide efficient, economical means to control odor, toxic vapors and corrosive gases. Several types of activated carbons are available for a variety of applications. Untreated activated carbons remove organic toxic gases such as trichloroethene, perchloroethene, benzene, toluene, ethylbenzene, xylenes and hydrocarbons. Chemically treated activated carbons remove specific gases such as hydrogen sulfide, sulfur dioxide, nitrogen oxides, halogens, mercury, aldehydes and mercaptans.

Specifications for each model are listed on reverse side.

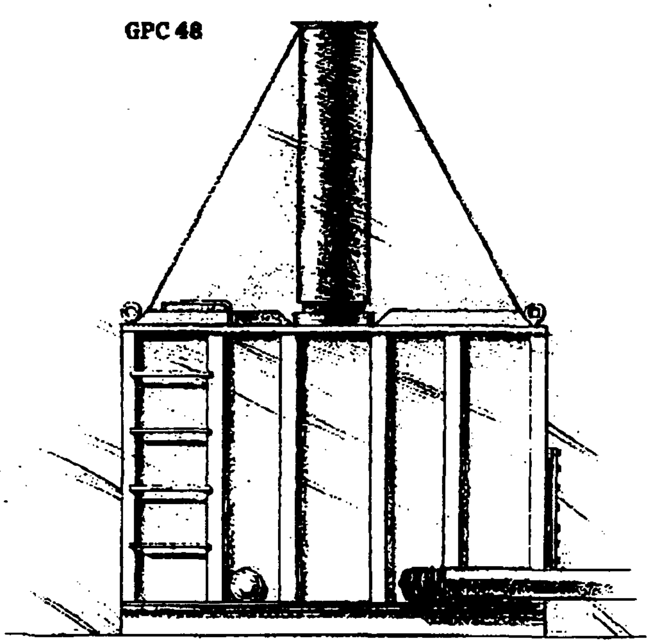
GPC 3 is ideal for controlling toxic vapor and corrosive gas vented from sources of small volume emission (storage tanks, reactor vessels, sewage treatment plants).

GPC 4 and 8 are designed specifically to control toxic vapor and corrosive gas vented from storage tanks, reactor vessels, sewage treatment plants and other sources of small volume emission. Welded steel construction provides exceptional strength and durability. The units are forklift compatible for trouble-free transportation and quick installation. Interiors are double-coated with a corrosion-resistant epoxy polyamide, ideal for the corrosive and abrasive conditions of gas phase service. Suitable for any gas phase application, including air stripper and soil venting off-gas treatment.

GPC 12, GPC 20 and GPC 48's welded steel construction provides exceptional strength and durability while the skid mounting and forklift compatibility make transportation and installation quick and trouble free. Interior is double coated with a corrosive-resistant epoxy polyamide, ideal for the corrosive and abrasive conditions of gas phase service. Suitable for any gas phase application, including air stripper and soil venting off-gas treatment.

GPC 70 and GPC 120 are among the largest gas phase carbon adsorbers available. Welded steel construction provides exceptional strength and durability, while the integrated lifting eyes and roll-off truck feature make transportation and installation quick and trouble free. Interior is double coated with a corrosion-resistant epoxy polyamide, ideal for the corrosive and abrasive conditions of gas phase service.

GPC 48



OPTIONS

Materials of construction.
Type of carbon.
Blower(s) and controls.
Humidity control.
Influent/effluent ducting.
Additional sampling couplings and valves.
Discharge stacks.

SPECIFICATIONS

Listed on other side.

CARBONAIR®
ENVIRONMENTAL SYSTEMS

640 Monticello Lane
Maple Grove, MN 55369-4547
612-425-2992 800-526-4999
Fax 612-425-6882

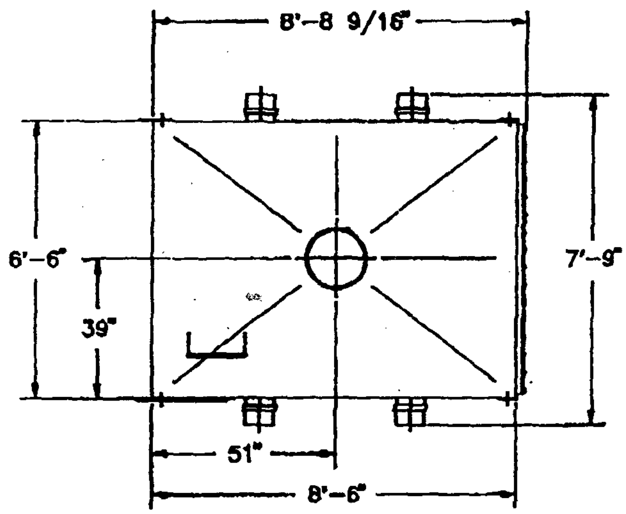
SPECIFICATIONS

MODELS	GPC 3	GPC 3H	GPC 3.85	GPC 4	GPC 8	GPC 12	GPC 20	GPC 48	GPC 70	GPC 120
DIMENSIONS	24½" OD (0.62 m) 36½" H (0.93 m)	24½" OD (0.62 m) 36½" H (0.93 m)	28½" OD (0.72 m) 38½" H (0.98 m)	24" L x 24" W x 46" H (0.6 m x 0.6 m x 1.2 m)	33" L x 33" W x 65¼" H (0.8 m x 0.8 m x 1.7 m)	4' L x 4' W x 7' H (1.2 m x 1.2 m x 2.1 m)	5' L x 5' W x 6' H (1.5 m x 1.5 m x 1.8 m)	8'6" L x 6'6" W x 6'3½" OH (2.6 m x 2.0 m x 1.9 m)	16'8½" L x 5' W x 7'6" OH (5.0 m x 1.5 m x 2.3 m)	16'6" L x 8' W x 7'10" H (5.0 m x 2.4 m x 2.4 m)
BED AREA	2.7 sq. ft. (0.26 sq. m)	2.7 sq. ft. (0.26 sq. m)	3.68 sq. ft. (0.34 sq. m)	4 sq. ft. (0.37 sq. m)	7.6 sq. ft. (0.71 sq. m)	12 sq. ft. (1.12 sq. m)	20 sq. ft. (1.86 sq. m)	48 sq. ft. (4.46 sq. m)	69.8 sq. ft. (6.49 sq. m)	120 sq. ft. (11.15 sq. m)
FLOW RANGE	20-100 cfm (0.6-3 m^3/min.)	20-270 cfm (0.6-8 m^3/min.)	36-360 cfm (1-10 m^3/min.)	40-400 cfm (1-10 m^3/min.)	76-760 cfm (2-20 m^3/min.)	120-1200 cfm (3-30 m^3/min.)	200-2000 cfm (6-60 m^3/min.)	480-4800 cfm (14-140 m^3/min.)	700-7000 cfm (20-200 m^3/min.)	1200-12,000 cfm (34-340 m^3/min.)
CARBON CAPACITY	150 lbs. (68 kg)	150 lbs. (68 kg)	250 lbs. (114 kg)	300 lbs. (136 kg)	750 lbs. (341 kg)	1,500 lbs. (681 kg)	2,000 lbs. (908 kg)	5,000 lbs. (2,270 kg)	10,000 lbs. (4,540 kg)	13,600 lbs. (6,174 kg)
FITTINGS	Two 1½" PVC influent/effluent connections	Two 4" PVC influent/effluent connections	Two 4" PVC influent/effluent connections	Two 4" NPT One ¾" drain	One 6" influent NPT One 8" effluent NPT One ¾" drain	One 6" quick-connect One 16" quick-connect One ¾" drain Two ¾" sample ports	One 6" quick-connect One 16" quick-connect One ¾" drain Two ¾" sample ports	Four 8" quick-connect air inlet ports One 16" quick-disconnect off-gas stack w/weather shield One ¾" condensation drain Two ¾" full-coupling sample ports	Six 12" quick-connect air inlet ports Two 16" quick-disconnect off-gas stacks w/weather shields One 1" condensation drain Two ¾" full-coupling sample ports	Four 20" quick-connect air inlet ports One 20" quick disconnect off-gas stacks w/weather shields One 1" condensation drain Two ¾" gauge/sample ports
EMPTY WEIGHT	65 lbs. (30 kg)	65 lbs. (30 kg)	100 lbs. (45 kg)	120 lbs. (55 kg)	450 lbs. (204 kg)	750 lbs. (340 kg)	900 lbs. (409 kg)	3,000 lbs. (1,362 kg)	5,500 lbs. (2,497 kg)	7,500 lbs (3,405 kg)
OPERATING WEIGHT	275 lbs. (125 kg)	275 lbs. (125 kg)	350 lbs. (159 kg)	420 lbs. (190 kg)	1,250 lbs. (568 kg)	2,250 lbs. (1,022 kg)	3,600 lbs. (1,634 kg)	10,000 lbs. (4,540 kg)	20,000 lbs. (9,080 kg)	27,220 lbs. (12,358 kg)
INLET PORTS	1½" (3.8 cm)	4" (10.2 cm)	4" (10.2 cm)	4" (10.2 cm)	6" (15.2 cm)	6" (15.2 cm)	6" (15.2 cm)	8" (20.3 m)	12" (30.5 cm)	20" (50.8 cm)
DISCHARGE STACKS (optional)	1½" (3.8 cm)	4" (10.2 cm)	4" (10.2 cm)	4" (10.2 cm)	8" (20.3 cm)	16" (40.6 cm)	16" (40.6 cm)	16" (40.6 cm)	16" (40.6 cm)	20" (50.8 cm)

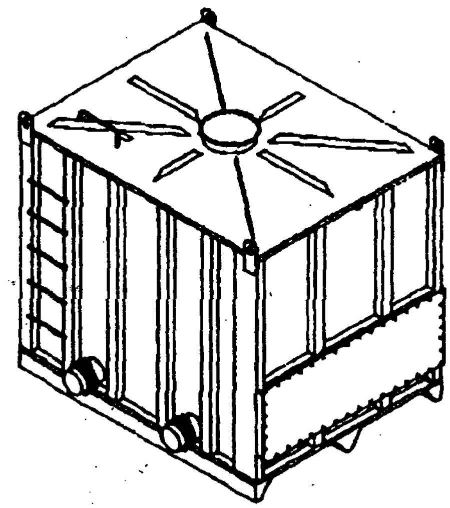
G-2

Carbon Adsorber–Vapor Phase
GPC 48

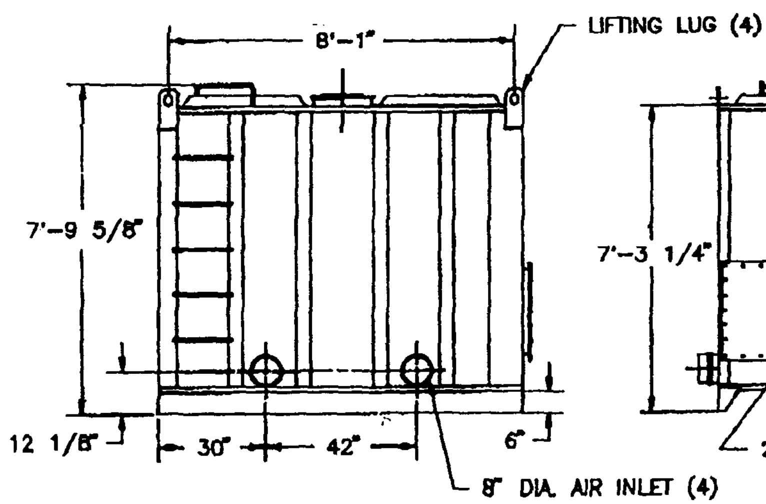
NOTE: VESSEL SHOWN WITH ALL CAPS AND COVERS INSTALLED.



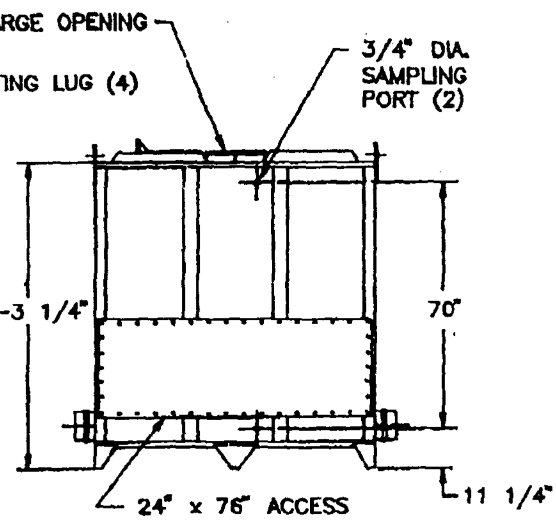
TOP VIEW



ISO VIEW
(3/4 SCALE)



SIDE VIEW



FRONT END VIEW

Sales Drawing #106991
91.08.09

VAPOR PHASE CARBON MODEL CALCULATIONS

CARBONAIR ENVIRONMENTAL SYSTEMS
8640 MONTICELLO LANE
MAPLE GROVE, MN 55369
PHONE: 612-425-2992
FAX: 612-425-6882

DESIGN COMPOUND	CIS-1,2-DCE	
EXPECTED CONC.	1.300	UG/L
MODEL CONC.	1.800	UG/L
TEMPERATURE	135.0	F
REL. HUMIDITY	50.00	%
OPERATING PRESS	760.0	MM MERCURY
VAPOR PRESSURE	682.8	MM MERCURY
K VALUE	151.2	(UMOLE/GM)(L/UMOLE)**1/N
1/N VALUE	0.7895	(DIMENSIONLESS)
CARBON CAPACITY	0.6344E-01	%
AIR FLOW RATE	550.0	CFM
CARBON USAGE	140.1	LB/DAY

CALGON
CALGON CARBON CORPORATION

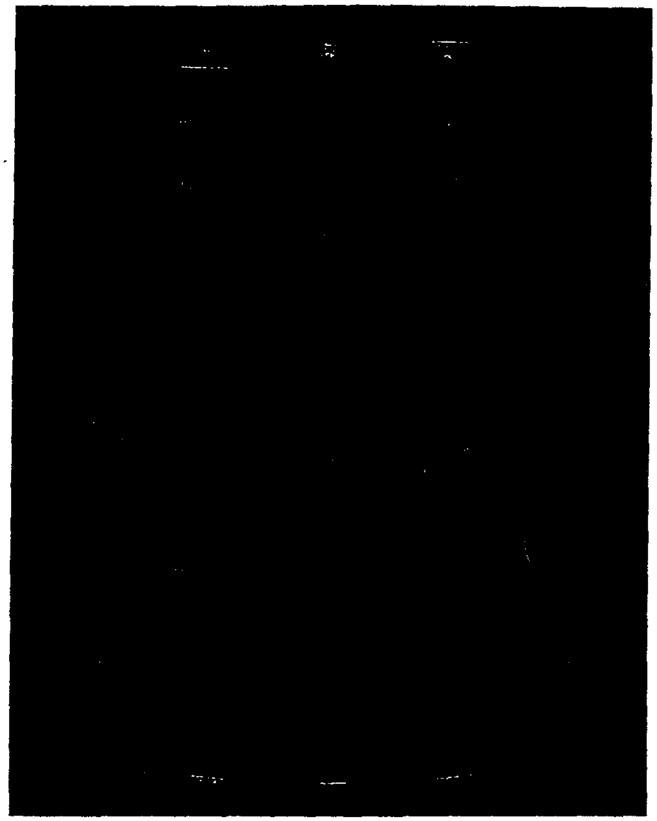
EQUIPMENT BULLETIN

FLOWSORB

GENERAL DESCRIPTION

Designed for low-flow water treatment applications, prefabricated 55-gallon FlowSorb™ canisters contain all the operating elements found in a full-scale adsorption system. These small, economical treatment systems hold 165 pounds of granular activated carbon for applications including:

- Small wastewater streams
- Groundwater remediation
- Underground storage tank leaks
- Well pump tests
- Product purification or decolorization
- Tank cleaning water treatment
- Batch water or product treatment
- Carbon adsorption pilot testing
- Emergency spill treatment
- Monitoring well water treatment



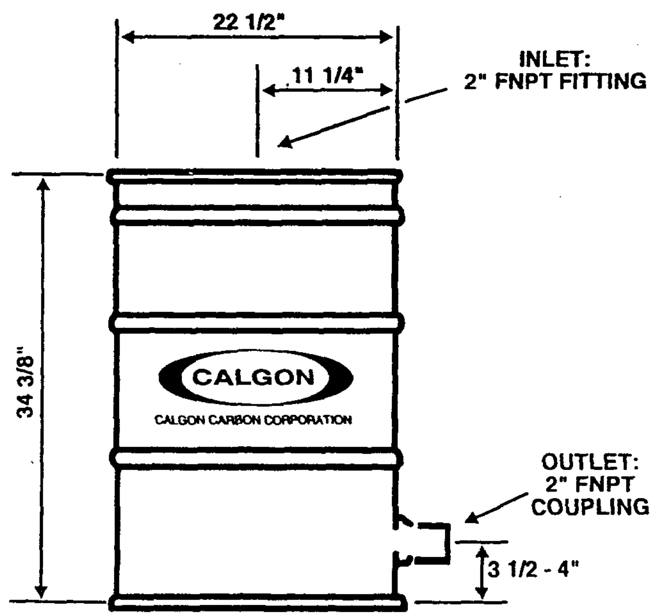
FEATURES

FlowSorb offers several features and benefits to industrial, commercial and municipal users including:

- Sturdy 16 gauge steel construction per DOT specifications
- Continuous treatment at varying flow rates and concentrations
- Simple installation and operation
- Space above carbon bed facilitates flow distribution or backflushing
- Flexibility to be used in series or parallel operation
- Supplied with virgin or reactivated carbon
- May also be supplied with Klensorb, an oil absorbent media
- Practical disposal option, as pre-approved spent carbon canisters may be returned to Calgon Carbon for safe carbon reactivation
- Low Cost per unit makes carbon treatment economical

FLOWSORB SPECIFICATIONS

Vessel: .... Open head 16 gauge steel canister
Pressure: .... 15 psig per DOT 17C
Cover: .... Removable steel cover, 12 gauge bolt ring with butyl rubber sponge gasket
Internal Coating: .... Heat cured phenolic epoxy
External Coating: .... Baked enamel (gray)
Temperature Limit: .... 150° F (65.6° C) continuous
350°F (176.7°C) intermittent
Inlet: .... 2" FNPT Nylon fitting
Outlet: .... 2" FNPT Galvanized steel coupling; 304 stainless steel collector in nylon drum fitting
Carbon: .... 165 pounds granular activated carbon: Specify Filtrasorb 300 or reactivated grade
Ship Weight: .... 232 pounds (105 kg)
Identification: .... Sequentially numbered for reference



FLOWSORB DIMENSIONS

CALGON CARBON CORPORATION • P.O. BOX 717 • PITTSBURGH, PA 15230-0717 • PHONE 1-800-4CARBON

TYPICAL FIOWSORB OPERATING PARAMETERS

Flow Rate: .... 10 gpm (37.8 l/m)
Contact Time: .... 4.5 minutes
Pressure Drop: .... < 1 psi (clean water and carbon)
Operating Pressures: .... Recommend operation at less than 5 psig, but higher pressures, up to 12 psig, possible with tight cover closure

FLOWSORB INSTALLATION

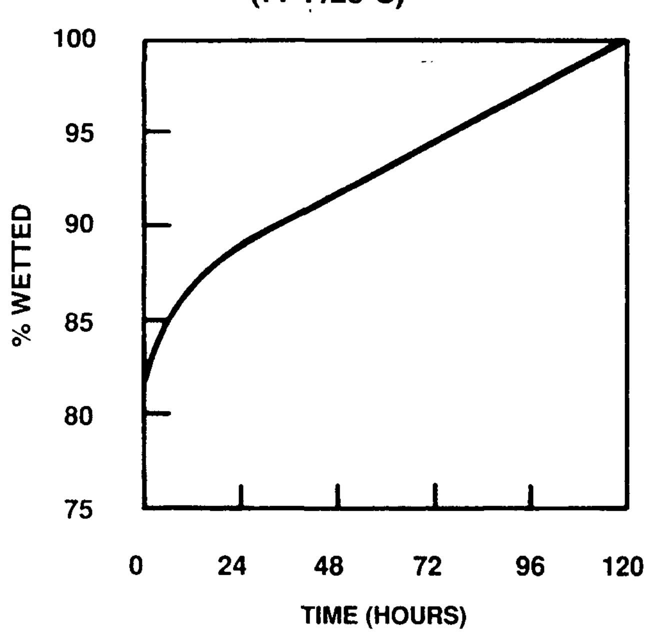
FlowSorb canisters are shipped with dry activated carbon; the carbon must be wetted and deaerated prior to use. This procedure displaces air from the internal structure of the carbon granule, thus assuring that the liquid to be treated is in contact with the carbon surface.

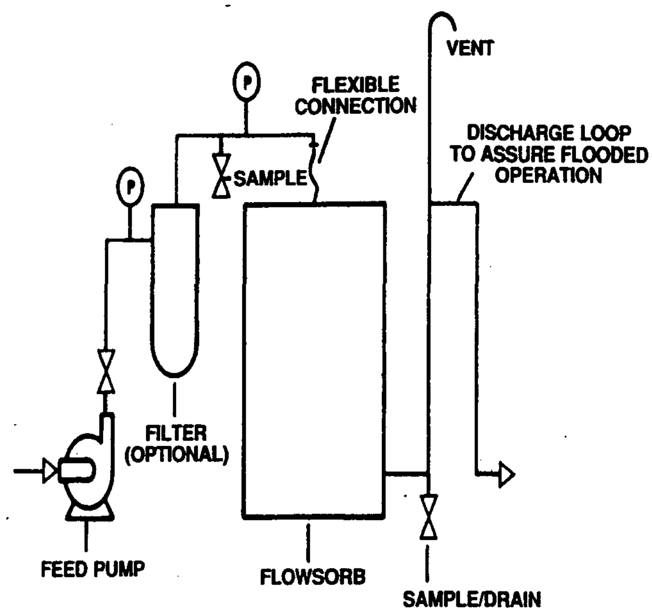
Prior to operation, each canister must be filled with clean water; the water should be introduced into the bottom outlet connection. The unit should set for approximately 48 hours — this allows most of the carbon's internal surface to become wetted, as shown on the wetting curve below.

After wetting, the carbon bed can be deaerated by draining the canister and again filling the canister upflow with clean water. This procedure will eliminate any air pockets which may have formed between the carbon granules. The FlowSorb is now ready for operation.

Canisters should be set on a flat, level surface and piped as recommended in the installation illustration. The influent pipe connection should be attached to the unit by using a flexible connection, as some minor deflection of the lid may occur if pressure builds due to filtration or other flow blockage downstream.

WETTING CURVE FOR GAC (77°F/25°C)





TYPICAL FLOWSORB INSTALLATION

FlowSorb discharge piping should include an elevated piping loop to assure that the canister remains flooded with water at all times. In addition to the piping loop, a drain connection is recommended on the discharge piping; this allows drainage of the unit prior to disconnection or temporary shutdown.

A filter should be installed if the liquid to be treated contains substantial amounts of suspended solids. A simple cartridge or screen filter helps prevent pressure buildup in the carbon bed.

FIOWSORB OPERATION

FlowSorb canisters should be full of clean water before treatment begins. Flow rate to the canister should be determined based on required contact time between the liquid and the carbon media. In groundwater treatment applications, the recommended contact time is typically 8-10 minutes with a resultant flow of approximately 5 gpm. Consult your Calgon Carbon Technical Sales Representative for advice about proper contact time for your application.

FlowSorbs can be manifolded in parallel operation for higher flow rates. For series operation, two FlowSorbs can be piped together sequentially, as normal pressure drop will not exceed the recommended operating pressure.

These canisters have space for bed expansion and can be backflushed by introducing clean water or liquid at approximately 20-25 gpm to the outlet and taking backflush water from the inlet.

If the operating pressure is expected to exceed 5 psig, an application of adhesive caulk at the lid gasket is recommended to prevent leakage. With all surfaces dry, apply the adhesive caulk to the lid recess and lip of the drum per the manufacturer's procedure and set the FlowSorb gasket into the lid recess. After allowing the caulk to set, install the drum lid and tighten the bolt ring.

THEORETICAL FLOWSORB TREATMENT CAPACITY FOR TYPICAL CASES

	Case 1 Conc.	Case 1 Gallons	Case 2 Conc.	Case 2 Gallons	Case 3 Conc.	Case 3 Gallons
Benzene	20 ppb	1,600,000	200 ppb	400,000	2 ppm	85,000
Toluene	40 ppb		400 ppb		4 ppm	
Xylene	40 ppb		400 ppb		4 ppm	

	Case 4 Conc.	Case 4 Gallons	Case 5 Conc.	Case 5 Gallons	Case 6 Conc.	Case 6 Gallons
TCE	50 ppb	1,900,000	500 ppb	550,000	5 ppm	125,000
PCE	50 ppb		500 ppb		4 ppm	

	Case 7 Conc.	Case 7 Gallons	Case 8 Conc.	Case 8 Gallons	Case 9 Conc.	Case 9 Gallons
Phenol	1 ppm	230,000	10 ppm	50,000	100 ppm	10,000
Total SOC	10 ppm		100 ppm		1,000 ppm	

Each case represents a groundwater or wastewater stream that contains the combination of contaminants listed. The treatment capacity indicates the total gallons of that particular water that may be treated before any of the specific contaminants are present in the treated water as noted. Theoretical capacity based on 5 gpm, water at 70°F or less and 165 pounds of Filtrasorb 300. Background TOC is less than 1 ppm except phenol cases as noted. Contaminants reduced to < 5 ppb, except phenol case which is for 95% phenol reduction.

HOW TO ESTIMATE FLOWSORB LIFE

The treatment table on this page lists the volume of water that can be purified by the FlowSorb for typical contamination situations. However, most applications involve a unique mixture of organic chemical contaminants including some chemicals that adsorb at different capacities or strengths. Please consult with your Calgon Carbon Technical Sales Representative for more information about carbon usage rates.

RETURN OF FLOWSORBS

Arrangements should be made at the time of purchase regarding the future return of canisters containing spent carbon. [redacted] contaminants are thermally destroyed. The company will not accept FlowSorbs for landfill, incineration or other means of disposal.

[redacted] carbon acceptance procedure has been completed, an [redacted] included with the units at the time of purchase) are attached.

[redacted]

SAFETY CONSIDERATIONS

It is unlikely that a worker would be able to physically enter a FlowSorb canister. However, the following information and precautions apply to a partially closed canister or situations where carbon is to be removed from the canister and stored elsewhere.

Wet or dry activated carbon preferentially removes oxygen from air. In closed or partially closed containers, oxygen depletion may reach hazardous levels. If workers must enter a vessel containing carbon, appropriate sampling and work procedures should be followed for potentially low-oxygen spaces – including all applicable federal and state requirements.

CALGON CARBON LIQUID PURIFICATION SYSTEMS

FlowSorb is a unit specifically designed for a variety of small flow applications. Calgon Carbon Corporation offers a wide range of carbon adsorption systems and services for a greater range of flow rates and carbon usages to meet specific applications.

WARRANTY

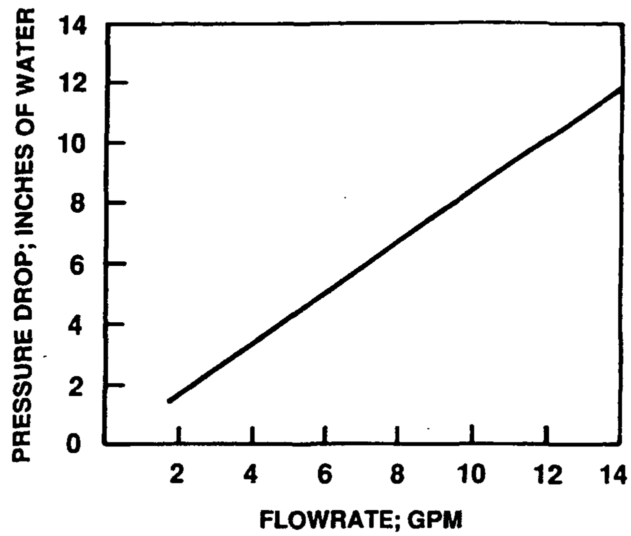
There are no expressed or implied warranties – or any warranty of merchantability or fitness – for a particular purpose associated with the sale of this product.

LIMITATION OF LIABILITY

The Purchaser's exclusive remedy for any cause of action arising out of purchase and use of the FlowSorb, including but not limited to breach of warranty, negligence and/or indemnifications, is expressly limited to a maximum of the purchase price of the FlowSorb unit as sold. All claims of whatsoever nature shall be deemed waived unless made in writing within forty-five (45) days of the occurrence giving rise to the claim. In no event shall Calgon Carbon Corporation for any reason be liable for incidental or consequential damages, in excess of the purchase price of the FlowSorb unit, loss of profits or fines imposed by governmental agencies.

For information regarding incidents involving human and environmental exposure, please call (412) 787-6700 and ask for the Regulatory and Trade Affairs Department.

FLOWSORB PRESSURE DROP



Application information provided in this bulletin is based upon theoretical data. Calgon Carbon Corporation assumes no responsibility for the use of the information in this product bulletin.

If at any time our products or services do not meet your requirements or expectations, or if you would like to suggest any ideas for improvement, please call us at 1-800-548-1999. From outside the U.S. please call +1-412-787-6700.

For detailed information on the products described in this bulletin, please contact one of our Regional Sales Offices located nearest to you:

New Jersey
Bridgewater, NJ 08807
Tel (908) 526-4646
Fax (908) 526-2467

Pennsylvania
Pittsburgh, PA 15230-0717
Tel (412) 787-6700
800/4-CARBON
Fax (412) 787-6676

Illinois
Lisle, IL 60532
Tel (708) 505-1919
Fax (708) 505-1936

California-North
San Mateo, CA 94404
Tel (415) 572-9111
Fax (415) 574-4466

Texas
Houston, TX 77040-6071
Tel (713) 690-2000
Fax (713) 690-7909

California-South
Carlsbad, CA 92008
Tel (619) 431-5550
Fax (619) 431-8169

Latin America/ Asia-Pacific
Pittsburgh, PA 15230-0717
Tel (412) 787-4519
Fax (412) 787-4523

Canada
Calgon Carbon Canada, Inc.
Mississauga, Ontario
Canada L4V 1N3
Tel (416) 673-7137
Fax (416) 673-8883

Europe
Chemviron Carbon
Brussels, Belgium
Tel 32 2 773 02 11
Fax 32 2 770 93 94

CALGON

CALGON CARBON CORPORATION

Judy Moore – (513) 874-1777
Fx -0707

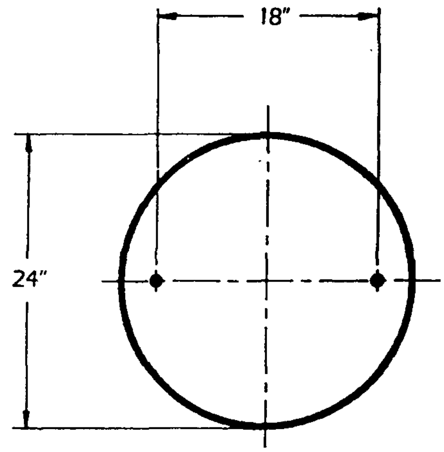
Water Purification System

AQUA-SCRUB™

ASC-200

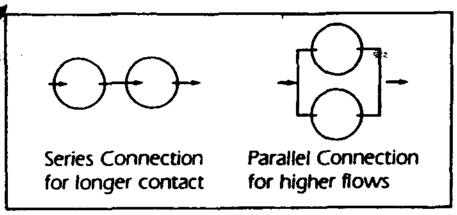
EASY TO INSTALL

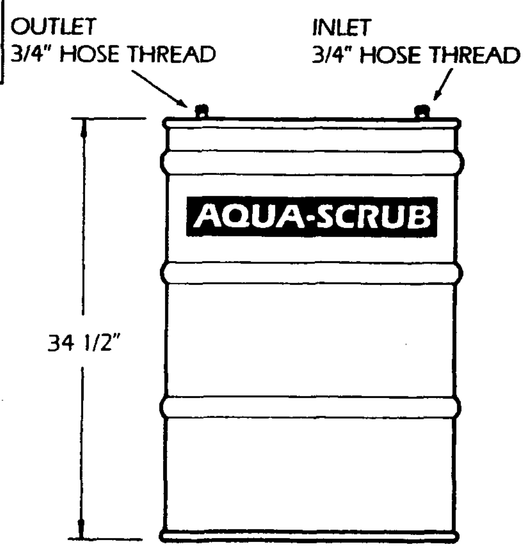
AQUA-SCRUB™ adsorbers are designed for fast and easy installation on any hard, flat surface. The only hardware needed is properly sized pipe or flexible hose for connection to the inlet/outlet ports. It is strongly recommended that a particulate filter be installed upstream from the AQUA-SCRUB™ adsorber.



CORROSION RESISTANCE

The combination of activated carbon and many VOC's can cause severe corrosion to metals, even stainless steel. AQUA-SCRUB™ adsorbers are designed to prevent these effects in normal service.





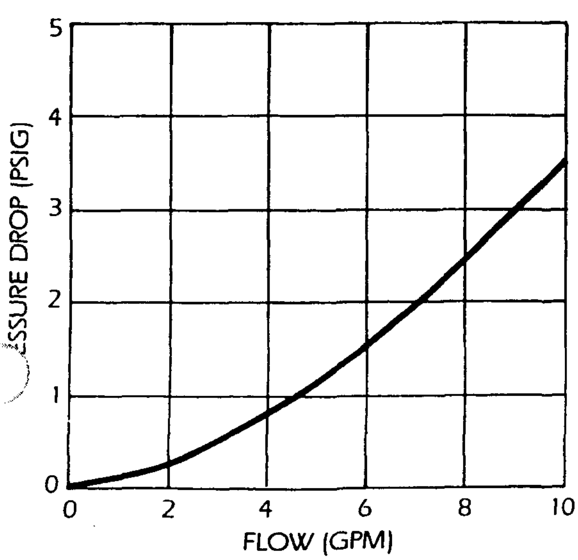
MATERIALS OF CONSTRUCTION

Vessel: Coated Carbon Steel
External Coating:
Powder Coat Enamel
Internal Coating: Polyethylene Lined
Piping: PVC

START-UP

Before beginning operation, AQUA-SCRUB™ adsorbers must be backfilled with water or liquid to be treated, and allowed to stand overnight to wet the carbon and eliminate all air (entrapped air is the most common cause of channeling).

PRESSURE DROP



SPECIFICATIONS	ASC-200-.75
Flow* gpm (max)	10
Pressure psig (max)	12
Temperature deg F (max)	120
Carbon Fill Volume (cu. ft.)	6.5
Cross Section (sq. ft.)	3.0
Shipping Weight (lbs.)	250

*Note: actual equipment selection should be based on required retention time.

All information presented here is believed to be reliable and in accordance with accepted engineering practice. However, Westates makes no warranties as to the completeness of the information. Users should evaluate the suitability of each product to their own particular application. In no case will Westates be liable for any special, indirect, or consequential damages arising from the sale, resale, or misuse of its products.

WESTATES ACTIVATED CARBON SYSTEMS

WESTATES CARBON, INC.
2130 Leo Ave., Los Angeles, CA 90040
PHONE: (213) 722-7500
FAX: (213) 722-8207 TWX: 910-321-2355

HIMCO DUMO SF SITE

Calculated (guesstimated) amount of VOCs in the condensate.

From drawing M1.2, landfill gas aatreatment system piping schematic, it appears that the condensate going to the liquid phase carbon treatment is water vapor that condensed in the landfill off-gas piping. If this is not correct, let me know.
The data I had to estimate the concentration of VOCs in the condensate was limited. In the specifications 11240-7,2.2.1.1, Design Conditions, concentrations of VOCs are listed and total to about 15 micrograms/liter. I don't know where these numbers came from. If these numbers are actual leachate concentrations they may be a fair estimate of the concentrations of VOCs in the condensate (i.e. the vapor in the landfill as measured in the soil gas sample will also be approximately in equilibrium with the leachate) **A possible problem with this data is that the concentrations are listed as ng/l. (1E-12). Analytical instruments can't measure them this low. This may be a typo and the concentrations are actually micrograms/liter (1E-9).** If this is the case, the total concentration of VOCs is 15 micrograms/literl.

One way of independently guesstimating the concentration of VOCs in the condensate is to assume the concentration of the VOCs leaving the ground and entering the piping system are the same concentration as VOCs found in the soil gas survey. Taking the highest number (12.2 ppb (para. 3.4 on page 2-3 of the DA) and assume that the vapors and condensate are in equilibrium, the concentration in the liquid phase can be estimated from Henry's law as follows:

.

P atm. = (H atm.) (X mole fract.)

Estimate the average Henry's constant for the VOCs to be 100 atm. (very conservative as Henry's Law Constant for TCE is about 500 atm.)

P atm. = 12.2 volumes of VOC/10E+9 volumes of gas = 1.22 E10-8 atm. VOC

X = P atm/H atm. = 1.22E10-8 atm. VOC/100 atm. = 1.22 E-10 mole fract

In a liter there are approx. 100 g-mole H2O/18 g H2O = 55.5 g-mole H2O/liter

(55.5) (1.22 E-10) ~= 6.8E-9 g mole VOC/liter

Assume the average molecular wt of the VOC's is 100 then:

(6.8E-9 g-mole VOC/liter) (100 g VOC/g-mole VOC) (1E6 mg VOC/g VOC) = **.68 mg/liter** (680 micrograms/liter) of VOC in the condensate.

If we assume an average Henry's constant of 1000 atm. (tetrachloroethylene) instead of 100, the concentration of VOCs in the condensate will be one tenth or 68 micrograms/liter. None of the numbers: 15 micrograms/liter or 15 ng/l from 11240-7,2.2.1.1; 68 mg/l or 680 micrograms/liter

ENCLOSURE 4

compare very well. Thus it is difficult to get a handle on the VOC concentration in the condensate from the data I had. The worst case above is **0.68 mg/liter**. This is fairly low. This is why I suggested seeing if the POTW will accept it without treatment. (I don't have Section 01402 which outlines the POTW discharge requirements to check this). The specs suggest using a 55-gallon size carbon unit. I suggest leaving a big enough footprint for installing a larger carbon unit if it is needed (or remove it of not needed) and putting it in a place where you can easily get it in/out of the building. Design Analysis, page 3-27, 3.3.2, Para 2 states that a pump test will be conducted. I suggest you consider collecting vapor samples during the pump test to analyze for VOCs. From this, the concentration of VOCs and sulfur species in the condensate can be estimated. Check with the district chemist or with Jim Cheney at the CX form information on how to collect VOC samples during the test. Special procedures are needed to collect gases for sulfur species.

H2S Calculation

I thought I had some isothermal data on H2S adsorption. I can't find it so I e-mailed a request to Calgon on Friday. As I recall, H2S does not adsorb very well on Carbon. The Landfill Off-Gas Collection & Treatment System, ETL 1110-1-160 states that H2S concentrations can vary from 11 to 700 ppmv in landfill off-gas. If I use a guesstimate of 5 per cent H2S adsorbed on carbon at equilibrium (5 lb H2S on 100 lb carbon) the following is the carbon usage:

(546 Ft3 gas/min) (700 ft3 H2S/1E6 ft gas) (lb-mole H2S/~370 ft3 H2S) (34 lb H2S/lb-mole H2S) (1440 min/day) = 52 lb H2S/day. @5% adsorption 52 lb /5% = 1040 lb carbon /day. 30 days of operation is 31,200 lb carbon. Ouch! I hope this is wrong.

This is not very clearly written so call me if you have any questions. I will call you when I get information back from Calgon on H2S adsorption.

Ed Mead
697-2576

APPENDIX H

REMEDIAL ACTION

HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX H

HYDRAULIC/HYDROLOGIC DESIGN CALCULATIONS

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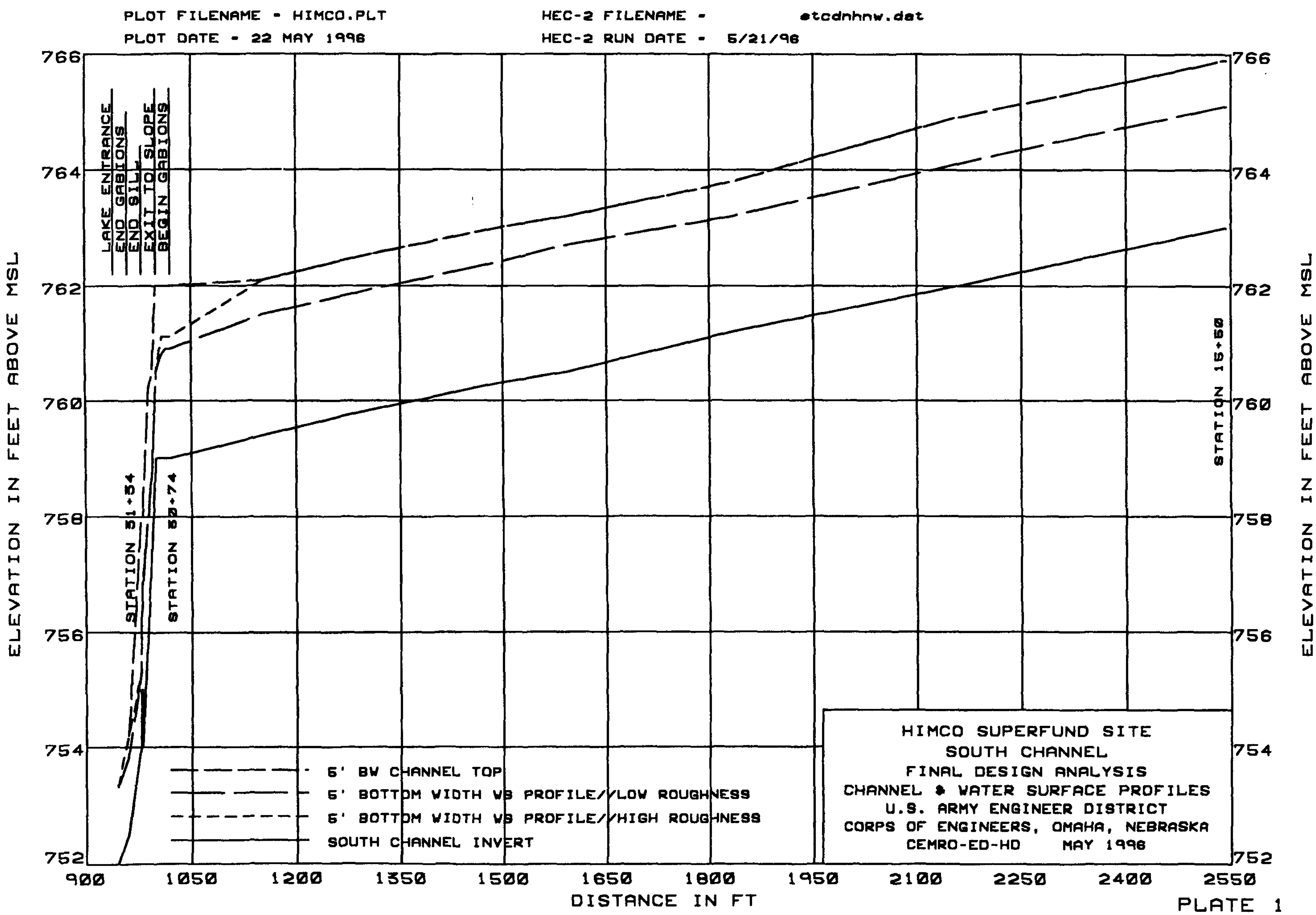
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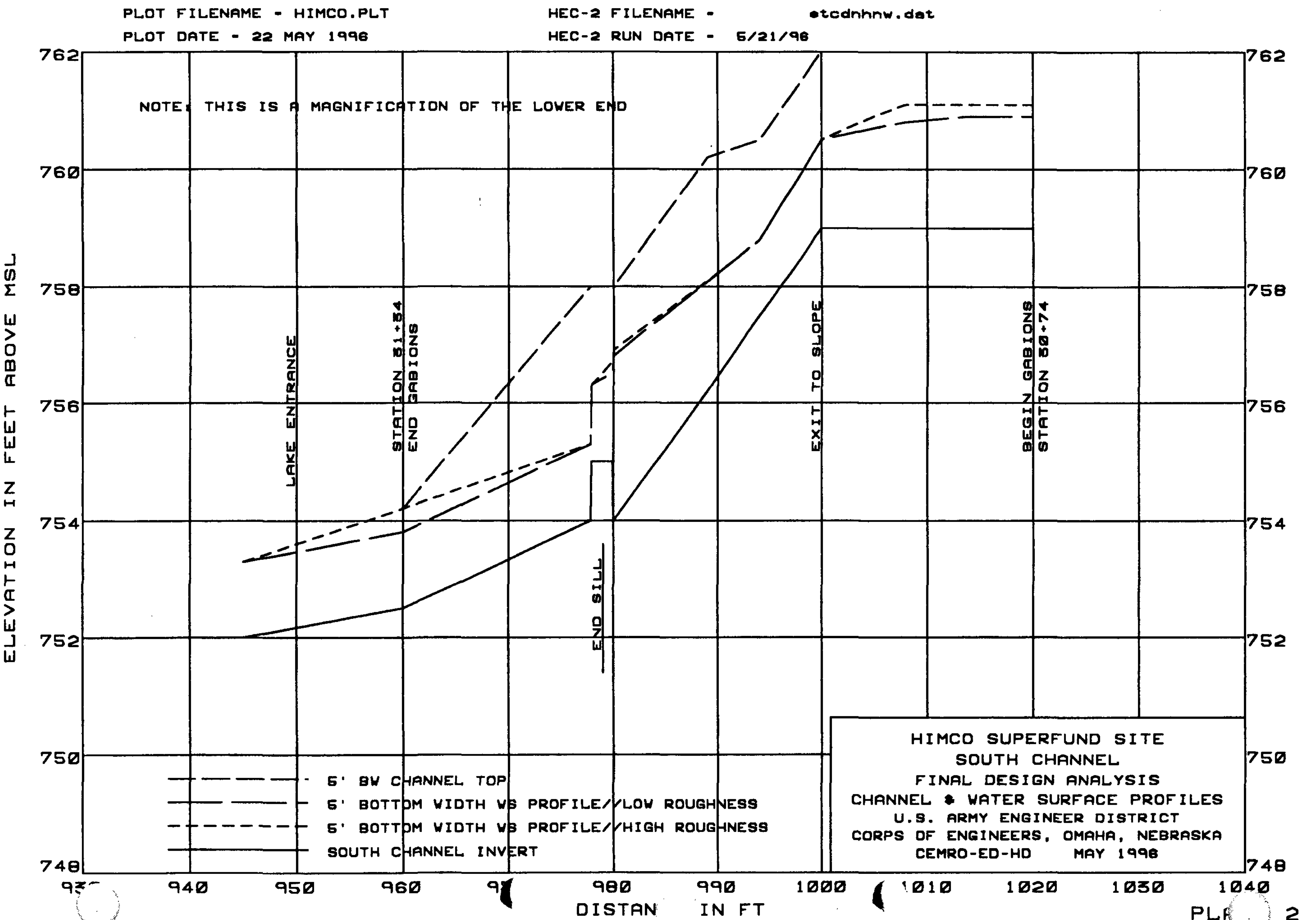
PLOT DATE - 22 MAY 1996
HEC-2 FILENAME - etcdnhnw.dat
HEC-2 RUN DATE - 5/21/96
LAKE ENTRANCE
END GABIONS
END SILL
EXIT TO SLOPE
BEGIN GABIONS
STATION 51+54
STATION 50+74
STATION 15+50
ELEVATION IN FEET ABOVE MSL
DISTANCE IN FT
5' BW CHANNEL TOP
5' BOTTOM WIDTH WS PROFILE/LOW ROUGHNESS
5' BOTTOM WIDTH WS PROFILE/HIGH ROUGHNESS
SOUTH CHANNEL INVERT
HIMCO SUPERFUND SITE
SOUTH CHANNEL
FINAL DESIGN ANALYSIS
CHANNEL & WATER SURFACE PROFILES
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS, OMAHA, NEBRASKA
CEMRO-ED-HD MAY 1996

PLATE 1



PLOT FILENAME - HIMCO.PLT
PLOT DATE - 22 MAY 1996
HEC-2 FILENAME - etcdnhnw.dat
HEC-2 RUN DATE - 5/21/96
NOTE: THIS IS A MAGNIFICATION OF THE LOWER END
LAKE ENTRANCE
STATION 51+54
END GABIONS
END SILL
EXIT TO SLOPE
BEGIN GABIONS
STATION 50+74
ELEVATION IN FEET ABOVE MSL
DISTAN IN FT
762
760
758
756
754
752
750
748
940
950
960
980
990
1000
1020
1030
1040
5' BW CHANNEL TOP
5' BOTTOM WIDTH WS PROFILE//LOW ROUGHNESS
5' BOTTOM WIDTH WS PROFILE//HIGH ROUGHNESS
SOUTH CHANNEL INVERT
HIMCO SUPERFUND SITE
SOUTH CHANNEL
FINAL DESIGN ANALYSIS
CHANNEL & WATER SURFACE PROFILES
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS, OMAHA, NEBRASKA
CEMRO-ED-HD MAY 1996

PL 2

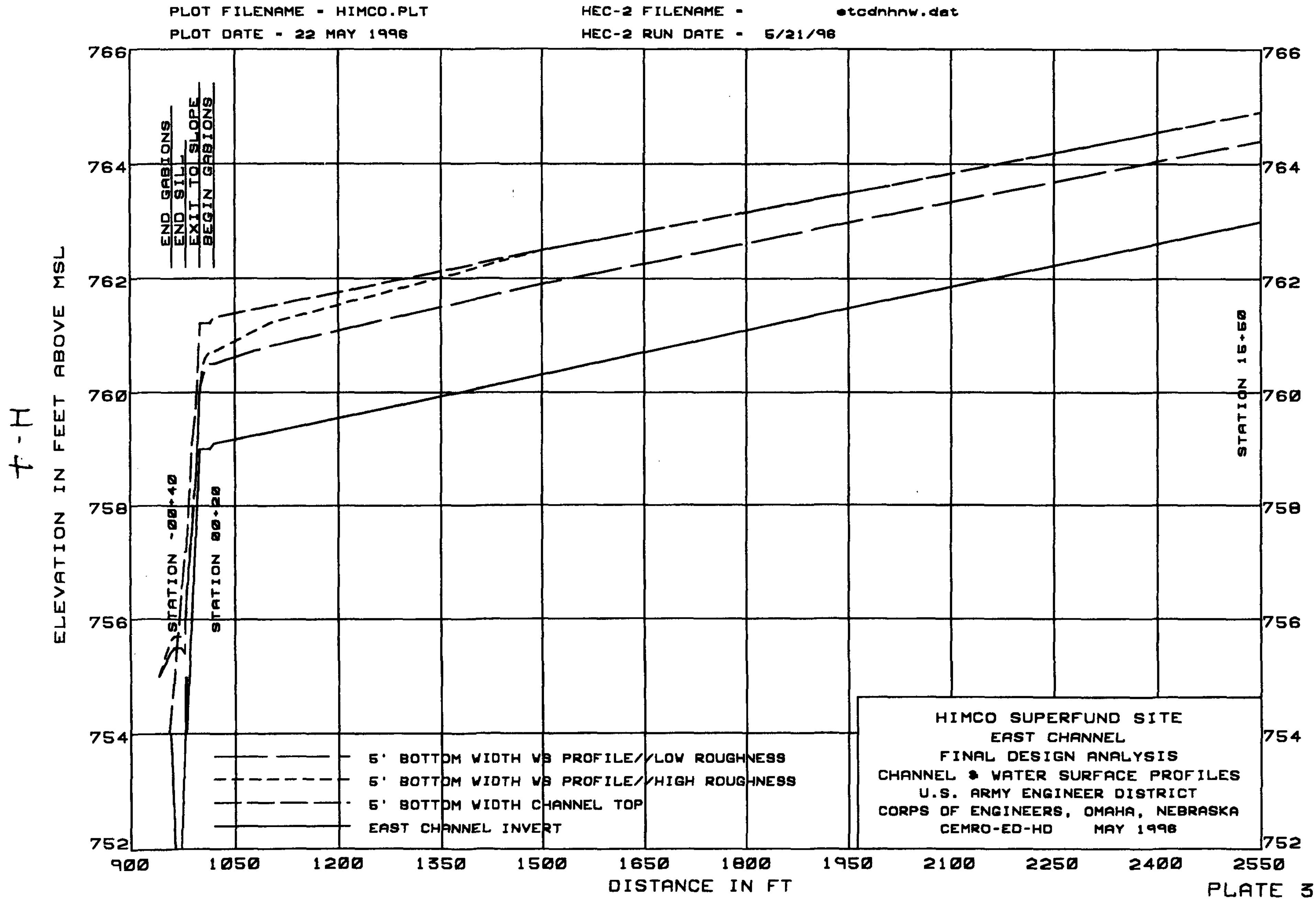
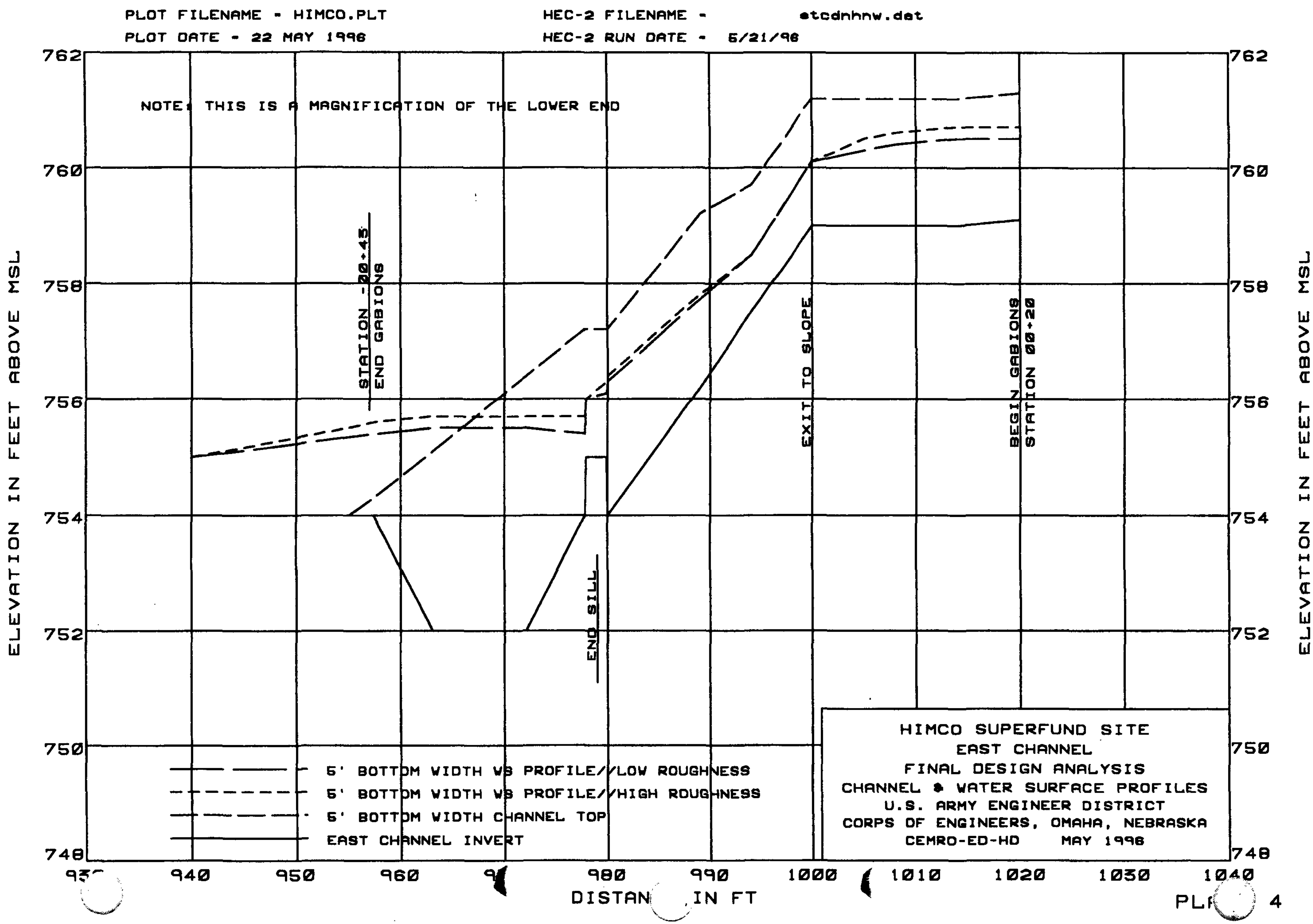

PLOT FILENAME - HIMCO.PLT
PLOT DATE - 22 MAY 1996
HEC-2 FILENAME - etcdnhnw.dat
HEC-2 RUN DATE - 5/21/96
END GABIONS
END SILL
EXIT TO SLOPE
BEGIN GABIONS
STATION -00+40
STATION 00+20
STATION 15+50
ELEVATION IN FEET ABOVE MSL
DISTANCE IN FT
5' BOTTOM WIDTH WS PROFILE//LOW ROUGHNESS
5' BOTTOM WIDTH WS PROFILE//HIGH ROUGHNESS
5' BOTTOM WIDTH CHANNEL TOP
EAST CHANNEL INVERT
HIMCO SUPERFUND SITE
EAST CHANNEL
FINAL DESIGN ANALYSIS
CHANNEL & WATER SURFACE PROFILES
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS, OMAHA, NEBRASKA
CEMRO-ED-HD MAY 1996
F-H

PLATE 3



PLOT FILENAME - HIMCO.PLT
PLOT DATE - 22 MAY 1996
HEC-2 FILENAME - etcdnhnw.dat
HEC-2 RUN DATE - 5/21/96
NOTE: THIS IS A MAGNIFICATION OF THE LOWER END
STATION -00+45
END GABIONS
END SILL
EXIT TO SLOPE
BEGIN GABIONS
STATION 00+20
ELEVATION IN FEET ABOVE MSL
762
760
758
756
754
752
750
748
940
950
960
980
990
1000
1010
1020
1030
1040
DISTAN IN FT
5' BOTTOM WIDTH WS PROFILE//LOW ROUGHNESS
5' BOTTOM WIDTH WS PROFILE//HIGH ROUGHNESS
5' BOTTOM WIDTH CHANNEL TOP
EAST CHANNEL INVERT
HIMCO SUPERFUND SITE
EAST CHANNEL
FINAL DESIGN ANALYSIS
CHANNEL & WATER SURFACE PROFILES
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS, OMAHA, NEBRASKA
CEMRO-ED-HD MAY 1996

PL 4

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO		SHEET NO. 1	OF 8
ITEM SOIL LOSS - USLE - avg annual		BY JMS	DATE 5/1/96
		CHKD. BY	DATE

USLE (UNIVERSAL SOIL LOSS EQUATION)

FROM: "Computation of Watershed Sediment Yield", May 1988
PRESENTED AT "Sediment Transport in Rivers + Reservoirs"
July 1988 - HEC, Davis, CA.

$$A = R * K * LS * C * P \quad (p. 3)$$

A, AVERAGE ANNUAL SHEET + RILL EROSION TONS/acre

K, SOIL ERODABILITY FACTOR (p. 8-10) TONS/acre/unit R

LS, length slope factor (p. 11-13)

C, Vegetative Cover factor (p. 14-15)

P, EROSION CONTROL PRACTICE FACTOR, (p. 16)

R, Rainfall erosion index (p. 4-6) $100 ft \cdot \frac{tons}{acre} \cdot \frac{inches}{hr}$

MRO Form 1550, 1 DEC 83

☆ U.S.G.P.O.: 1993-556-577

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO		SHEET NO. 2	OF 8
ITEM SOIL LOSS - USLE - AVERAGE ANNUAL		BY	DATE 5/1/96
		CHKD. BY	DATE

K, SOIL ERODABILITY FACTOR

K = 0.30 tons/acre/unit R

– representative of soils listed as good for use as topsoil in the Soil Survey for Elkhart County, Indiana as recommended by Geotech.

R, Rainfall erosion index (p. 4-7)

FIGURE 1 – NORTH CENTRAL INDIANA

R = 150 (100 ft · tons/acre · inches/hr)

P, EROSION CONTROL PRACTICE FACTOR (p. 16)

P = 1 - undisturbed, future conditions

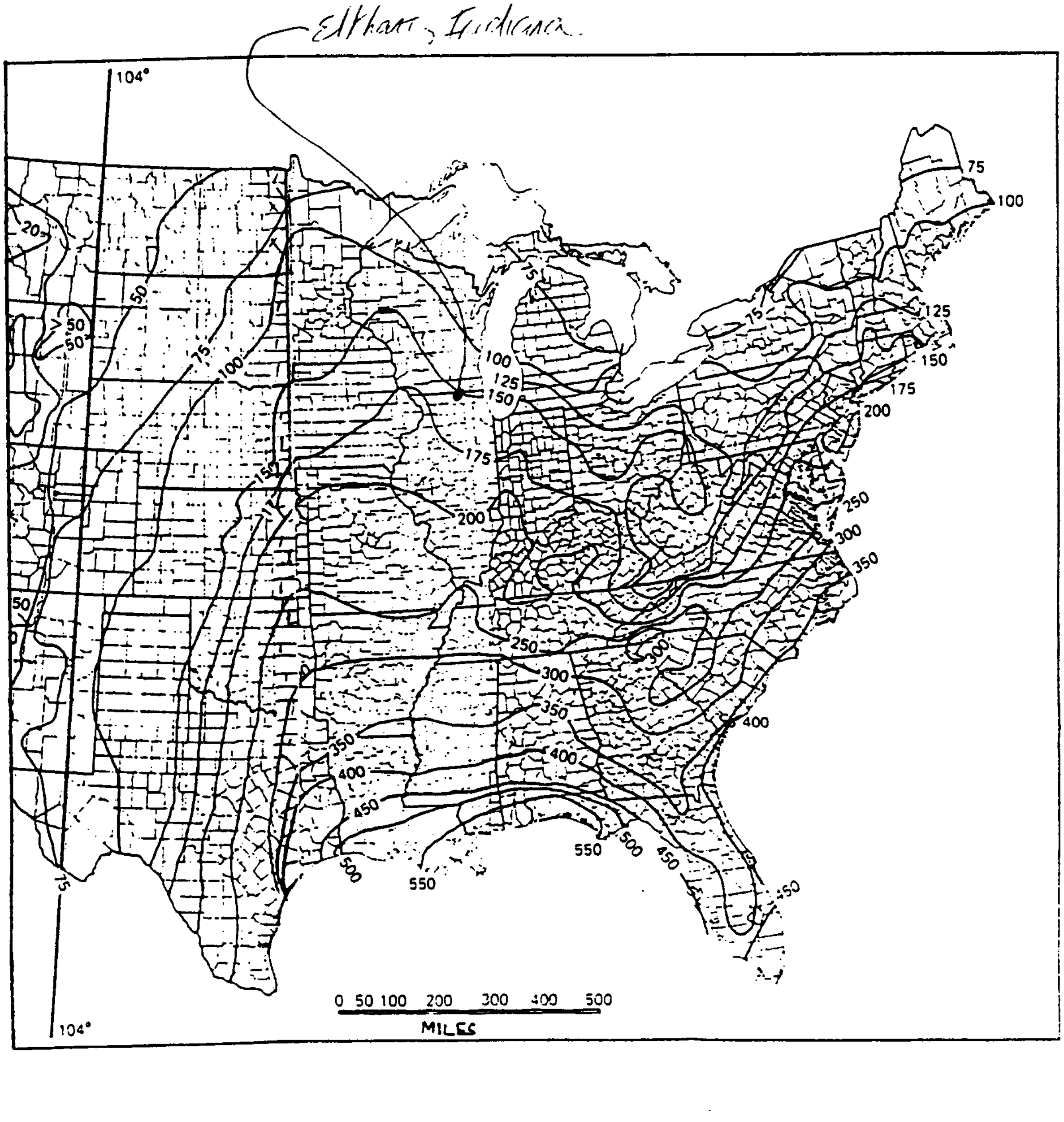


Figure 1 R values for areas east of 104 degrees longitude.

Erosion Control Practice Factor, P

The erosion control practice factor is defined as the ratio of soil loss with a given surface condition to soil loss with up and down hill plowing. This factor has significance mainly for disturbed areas. For agricultural land, P is used to describe plowing and tillage practices. For construction areas, P is used to describe the change in roughness of the soil surface due to grading. For undisturbed land, use P = 1. For other cases use the following guidelines:

Surface Condition	P Value
Compacted and smoothed	1.3
Track marks or furroughs oriented downslope	1.2
Track marks or furroughs oriented across slope	0.9
Straw punched with sheeps foot roller	0.9
Rough, irregular grading	0.9
Loose soil to a 12 inch depth	0.8

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO		SHEET NO. 5	OF 8
ITEM SOIL LOSS - USLE - AVERAGE ANNUAL		BY	DATE 5/1/96
		CHKD. BY	DATE

LS LENGTH SLOPE FACTOR (p. 11-13)

$l_{avg} = 390'$ - slope length in feet

$s = 4\%$ - field slope in percent

$$L = \left(\frac{l}{73}\right)^{0.4} = \left(\frac{390}{73}\right)^{0.4} = 1.95$$

$$S = \frac{0.43 + 0.30s + 0.043s^2}{6.613} = \frac{0.43 + 0.30(4) + 0.043(4)^2}{6.613} = 0.35$$

$$LS = 1.95(0.35) = 0.69$$

C, VEGETATIVE COVER FACTOR (p. 14-15)

$$C = C1 * C2 * C3$$

C1, Canopy cover factor (TREES + BRUSH)

$C1 = 1.0$ (NO canopy)

C2, CONTACT VEGETATION FACTOR

$C2 = 0.20$ (70% ground cover)

C3, TILLAGE / LANDUSE FACTOR

$C3 = 0.375$ (50% grass/weeds)

$$C = 1.0(0.2)(0.375) = 0.075$$

Table 2 Values of LS for various lengths and slopes.

Slope ratio	Slope gradient s, %	10 (3.0)	20 (6.1)	30 (9.1)	40 (12.2)	50 (15.2)	60 (18.3)	70 (21.3)	80 (24.4)	90 (27.4)	100 (30.5)
	0.5	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.09	0.09	0.10
100:1	1	0.08	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.12	0.12
	2	0.10	0.12	0.14	0.15	0.16	0.17	0.18	0.19	0.19	0.20
	3	0.14	0.18	0.20	0.22	0.23	0.25	0.26	0.27	0.28	0.29
	4	0.16	0.21	0.25	0.28	0.30	0.33	0.35	0.37	0.38	0.40
20:1	5	0.17	0.24	0.29	0.34	0.38	0.41	0.45	0.48	0.51	0.53
	6	0.21	0.30	0.37	0.43	0.48	0.52	0.56	0.60	0.64	0.67
	7	0.26	0.37	0.45	0.52	0.58	0.64	0.69	0.74	0.78	0.82
12½:1	8	0.31	0.44	0.54	0.63	0.70	0.77	0.83	0.89	0.94	0.99
	9	0.37	0.52	0.64	0.74	0.83	0.91	0.98	1.05	1.11	1.17
10:1	10	0.43	0.61	0.75	0.87	0.97	1.06	1.15	1.22	1.30	1.37
	11	0.50	0.71	0.86	1.00	1.12	1.22	1.32	1.41	1.50	1.58
8:1	12.5	0.61	0.86	1.05	1.22	1.36	1.49	1.61	1.72	1.82	1.92
	15	0.81	1.14	1.40	1.62	1.81	1.98	2.14	2.29	2.43	2.56
6:1	16.7	0.96	1.36	1.67	1.92	2.15	2.36	2.54	2.72	2.88	3.04
5:1	20	1.29	1.82	2.23	2.58	2.88	3.16	3.41	3.65	3.87	4.08
4½:1	22	1.51	2.13	2.61	3.02	3.37	3.69	3.99	4.27	4.53	4.77
4:1	25	1.86	2.63	3.23	3.73	4.16	4.56	4.93	5.27	5.59	5.89
	30	2.51	3.56	4.36	5.03	5.62	6.16	6.65	7.11	7.54	7.95
3:1	33.3	2.98	4.22	5.17	5.96	6.67	7.30	7.89	8.43	8.95	9.43
	35	3.23	4.57	5.60	6.46	7.23	7.92	8.55	9.14	9.70	10.22
2½:1	40	4.00	5.66	6.93	8.00	8.95	9.80	10.59	11.32	12.00	12.65
	45	4.81	6.80	8.33	9.61	10.75	11.77	12.72	13.60	14.42	15.20
2:1	50	5.64	7.97	9.76	11.27	12.60	13.81	14.91	15.94	16.91	17.82
	55	6.48	9.16	11.22	12.96	14.48	15.87	17.14	18.32	19.43	20.48
1¾:1	57	6.82	9.64	11.80	13.63	15.24	16.69	18.03	19.28	20.45	21.55
	60	7.32	10.35	12.68	14.64	16.37	17.93	19.37	20.71	21.96	23.15
1½:1	66.7	8.44	11.93	14.61	16.88	18.87	20.67	22.32	23.87	25.31	26.68
	70	8.98	12.70	15.55	17.96	20.08	21.99	23.75	25.39	26.93	28.39
	75	9.78	13.83	16.94	19.56	21.87	23.95	25.87	27.66	29.34	30.92
1¼:1	80	10.55	14.93	18.28	21.11	23.60	25.85	27.93	29.85	31.66	33.38
	85	11.30	15.98	19.58	22.61	25.27	27.69	29.90	31.97	33.91	35.74
	90	12.02	17.00	20.82	24.04	26.88	29.44	31.80	34.00	36.06	38.01
	95	12.71	17.97	22.01	25.41	28.41	31.12	33.62	35.94	38.12	40.18
1:1	100	13.36	18.89	23.14	26.72	29.87	32.72	35.34	37.78	40.08	42.24

Slope ratio	Slope gradient s, %	150 (46)	200 (61)	250 (76)	300 (91)	350 (107)	400 (122)	450 (137)	500 (152)	600 (183)	700 (213)	800 (244)	900 (274)
	0.5	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.15
100:1	1	0.14	0.14	0.15	0.16	0.16	0.16	0.17	0.17	0.18	0.18	0.19	0.19
	2	0.23	0.25	0.26	0.28	0.29	0.30	0.32	0.33	0.34	0.36	0.37	0.39
	3	0.32	0.35	0.38	0.40	0.42	0.43	0.45	0.46	0.49	0.51	0.54	0.55
	4	0.47	0.53	0.58	0.62	0.66	0.70	0.73	0.76	0.82	0.87	0.92	0.96
20:1	5	0.66	0.76	0.85	0.93	1.00	1.07	1.13	1.20	1.31	1.42	1.51	1.60
	6	0.82	0.95	1.06	1.16	1.26	1.34	1.43	1.50	1.65	1.78	1.90	2.02
	7	1.01	1.17	1.30	1.43	1.54	1.65	1.75	1.84	2.02	2.18	2.33	2.47
12½:1	8	1.21	1.40	1.57	1.72	1.85	1.98	2.10	2.22	2.43	2.62	2.80	2.97
	9	1.44	1.66	1.85	2.03	2.19	2.35	2.49	2.62	2.87	3.10	3.32	3.52
10:1	10	1.68	1.94	2.16	2.37	2.56	2.74	2.90	3.06	3.35	3.62	3.87	4.11
	11	1.93	2.23	2.50	2.74	2.95	3.16	3.35	3.53	3.87	4.18	4.47	4.74
8:1	12.5	2.35	2.72	3.04	3.33	3.59	3.84	4.08	4.30	4.71	5.08	5.43	5.76
	15	3.13	3.62	4.05	4.43	4.79	5.12	5.43	5.72	6.27	6.77	7.24	7.68
6:1	16.7	3.72	4.30	4.81	5.27	5.69	6.08	6.45	6.80	7.45	8.04	8.60	9.12
5:1	20	5.00	5.77	6.45	7.06	7.63	8.16	8.65	9.12	9.99	10.79	11.54	12.24
4½:1	22	5.84	6.75	7.54	8.26	8.92	9.54	10.12	10.67	11.68	12.62	13.49	14.31
4:1	25	7.21	8.33	9.31	10.20	11.02	11.78	12.49	13.17	14.43	15.58	16.66	17.67
	30	9.74	11.25	12.57	13.77	14.88	15.91	16.87	17.78	19.48	21.04	22.49	23.86
3:1	33.3	11.55	13.34	14.91	16.33	17.64	18.86	20.00	21.09	23.10	24.95	26.67	28.29
	35	12.52	14.46	16.16	17.70	19.12	20.44	21.68	22.86	25.04	27.04	28.91	30.67
2½:1	40	15.50	17.89	20.01	21.91	23.67	25.30	26.84	28.29	30.99	33.48	35.79	37.96
	45	18.62	21.50	24.03	26.33	28.44	30.40	32.24	33.99	37.23	40.22	42.99	45.60
2:1	50	21.83	25.21	28.18	30.87	33.34	35.65	37.81	39.85	43.66	47.16	50.41	53.47
	55	25.09	28.97	32.39	35.48	38.32	40.97	43.45	45.80	50.18	54.20	57.94	61.45
1¾:1	57	26.40	30.48	34.08	37.33	40.32	43.10	45.72	48.19	52.79	57.02	60.96	64.66
	60	28.35	32.74	36.60	40.10	43.31	46.30	49.11	51.77	56.71	61.25	65.48	69.45
1½:1	66.7	32.68	37.74	42.19	46.22	49.92	53.37	56.60	59.66	65.36	70.60	75.47	80.05
	70	34.77	40.15	44.89	49.17	53.11	56.78	60.23	63.48	69.54	75.12	80.30	85.17
	75	37.87	43.73	48.89	53.56	57.85	61.85	65.60	69.15	75.75	81.82	87.46	92.77
1¼:1	80	40.88	47.20	52.77	57.81	62.44	66.75	70.80	74.63	81.76	88.31	94.41	100.13
	85	43.78	50.55	56.51	61.91	66.87	71.48	75.82	79.92	87.55	94.57	101.09	107.23
	90	46.55	53.76	60.10	65.84	71.11	76.02	80.63	84.99	93.11	100.57	107.51	114.03
	95	49.21	56.82	63.53	69.59	75.17	80.36	85.23	89.84	98.42	106.30	113.64	120.54
1:1	100	51.74	59.74	66.79	73.17	79.03	84.49	89.61	94.46	103.48	111.77	119.48	126.73

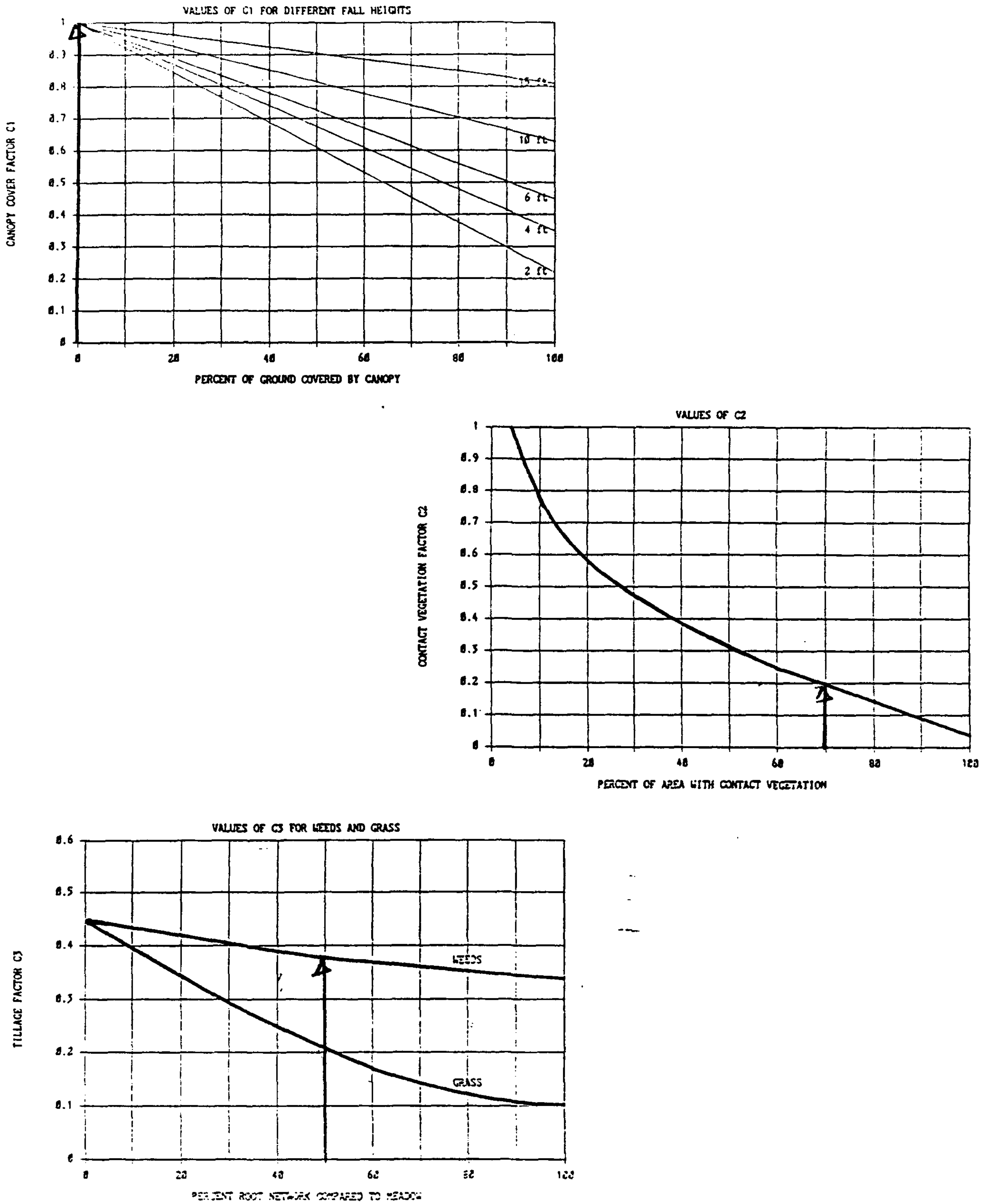


Figure 4 Graphs for determining cover factors C1, C2, and C3.

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO		SHEET NO. 8	OF 8
ITEM SOIL LOSS-USLE → AVERAGE ANNUAL		BY TDB	DATE 5/1/96
		CHKD. BY	DATE

USLE:

$A = R * K * LS * C * P$ = average annual sheet + rill erosion

$A = 150(0.30)(0.69)(0.075)(1) = \underline{\underline{2.33}}$ tons/acre/yr

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO	SHEET NO. 1	OF 4
ITEM SOIL LOSS - MUSLE - 25yr-24 hr EVENT	BY [initials] DATE 5/1/90	CHKD. BY DATE

MUSLE - MODIFIED UNIVERSAL SOIL LOSS EQUATION

$$A = R_1 * K_1 * LS * C * P$$

A, TOTAL SHEET AND RILL EROSION FOR A SINGLE STORM EVENT (TONS)

R_1, STORM RUNOFF ENERGY FACTOR (100FT-TONS-INCHES/hr)

LS, SAME AS USLE

C, " "

P, " "

K, " "

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO		SHEET NO. 2	OF 4
ITEM MUSLE - 25yr - 24hr event		BY	DATE 5/1/96
		CHKD. BY	DATE

$\underline{R}$, STORM RUNOFF ENERGY FACTOR

$R = a * (V * Q)^b$

a = 95 b = 0.56 - empirical constants

V - storm event runoff volume (acre-ft)

Q - storm event peak discharge (cfs)

25yr - 24hr storm event (from hydrology appendix)

ONSITE:

Q_N = 117 cfs V_N = 9 acre-ft R_N = 4650 (100 ft. tons. inches / hr)

Q_W = 80 cfs V_W = 6 acre-ft R_W = 3015 " "

OFFSITE:

Q_N = 32 cfs V = 7 acre-ft R_N = 1967 " "

Q_W = 42 cfs V = 17 acre-ft R_W = 3765 " "

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO		SHEET NO. 3	OF 4
ITEM MUSLE - 25yr-24 hr event		BY CB	DATE 5/1/96
		CHKD. BY	DATE

LS, length slope factor

ONSITE:

Same as USLE, LS=0.69 (400'=l, 4% slope)

OFFSITE:

probably less, but assume the same for quick calcs.

C, VEGETATIVE COVER FACTOR

ONSITE:

SAME AS USLE, C=0.075

OFFSITE:

$C_1 = 0.85$ (30% canopy, 6-10' drop)

$C_2 = 0.1$ (90% CONTACT VEGETATION)

$C_3 = .25$ (90% grass + WEEDS)

$C = C_1 \cdot C_2 \cdot C_3 = 0.021$

P, EROSION CONTROL PRACTICE FACTOR

P=1, UNDISTURBED

K, soil erodibility factor

K=0.2

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO		SHEET NO. 4	OF 4
ITEM MUSLE - 25yr - 24 hr. Event		BY	DATE 5/1/96
		CHKD. BY	DATE

$$A = R * K * LS * C * P$$

ONSITE:

$$A_N = 4680(0.3)(0.69)(\cancel{.021}\ .075)(1) = 72.7 \text{ TONS}$$

$$A_W = 3015(0.3)(0.69)(0.075)(1) = 46.8 \text{ TONS}$$

OFFSITE:

$$A_N = 1967(0.2)(0.69)(.021)(1) = 5.7 \text{ TONS}$$

$$A_W = 3765(0.2)(0.69)(.021)(1) = 10.9 \text{ TONS}$$

TOTAL:

$$A_N = 72.7 + 5.7 = 78.4 \text{ TONS} \Rightarrow 0.051 \text{ acre-ft (into North area)}$$

$$A_W = 46.8 + 10.9 = 57.7 \text{ TONS} \Rightarrow 0.038 \text{ acre-ft (into West borrow area)}$$

Conversion:

$$X \text{ TONS} \left(\frac{2000 \text{ lbs}}{1 \text{ TON}}\right)\left(\frac{ft^3}{70 \text{ lb}}\right)\left(\frac{1 \text{ acre-ft}}{43{,}560 \text{ ft}^3}\right) = y \text{ acre-ft}$$

(assuming soil density 70 lb/ft³)

∴ Sediment yield is minimal compared to the available storage volume + requires no special features or added storage.

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO Superfund		SHEET NO. 1	OF
ITEM SENSITIVITY ANALYSIS Reservoir Size / Starting GWater EL		BY M. Nelson	DATE 29 Mar 96
		CHKD. BY	DATE

I GROUND WATER INFO

A Wells in 30% Design Shown on Map

1980 - 1989 DATA

WELL DESIGNATION	MIN	MEAN	MAX	Close to
WT B2	754.23	756.27	759.23	Borrow Area
WT 01	751.36	753.11	756.12	Quarry Pit

B FOR CONDITION 2 PONDS
Use 759.2 starting el. for West borrow pit
Use 756.1 Starting el. for east quarry

C For Combination
Use $\frac{759.2+756.1}{2} = 757.7'$

II CONDITIONS TO MODEL

A. Small Reservoirs Low (1995) groundwater levels -DONE-
& ORIGINAL AREAS
B. ~~Small Reservoirs~~ High (1980-1989) groundwater levels
Using near Quarry infilt. Rates of 5 iph.
C. Linked Large Reser. Low (1995) groundwater levels
D. ~~Linked~~ Large Reserv. High (1980-1989) groundwater level = 757.7'
B. Separate Reservoirs, New Grading Low (1995) Ground Water Levels
West = 755.0 East = 754.0
C. Separate Reservoirs, New Grading 10-YR HIGH (1980-89) GW Levels
West = 759.2 East = 756.1
D. Mean Annual Runoff

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO Superfund	SHEET NO. 2 OF	
ITEM SENSITIVITY ANALYSIS	BY M. Nelson	DATE 29Mar96
	CHKD. BY	DATE

SEPARATE RESERVOIRS, NEW GRADING – High GROUNDWATER 1980–1989 max.

A. Change subbasin infiltration rates around sand pits to 5 iph for disturbed sand & gravel

B. Make outflow to Swale have elevation 758.0 & compute discharge from Swale

C. Dimensions from BRIAN CIBAR

1) West Borrow Pit

EL	A (acres)
755.0	13.85
758.0	18.54
(758.2)	(18.75)
759.0	19.61

a) Overflow to West begins at El = 758.2
bottom width is 10'
Sideslope is 1% up to 758.7

2) East Quarry Area

EL	A (acres)
754.0	10.59
756.0	16.44
(756.1)	(16.55)
757.0	17.52
(758.0)	(18.60)

a) Inlet invert of 30" RCP is at elevation 757.1

b) Assume flap gate & no water allowed to flow into neighborhood.

East Quarry Cap

Time	A_1		A_2		A_4	$A_{cap\,Total}$	A_3	A_5
1200	4	⇒	8	+	16	24	1	1
1205	9		15	+	29	44	2	2
1210	15		28	+	52	80	3	3
1215	17		38	+	72	110	5	4
1220	15		39	+	78	117	7	5
1225	11		35		74	109	10	5
1230	8		29		65	94	12	5
1235	6		23		55	78	16	5
1240	5		18		46	64	19	5
1245	4		14		37	51	21	

Bcapt
64
80
80 =
68

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO – Superfund	SHEET NO. 3 OF	
ITEM Sensitivity Analysis	BY M. Nelson	DATE 1 Apr 96
	CHKD. BY	DATE

III. Modifications to HEC-1 Model

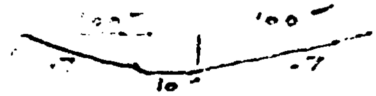
1. West Borrow Pit

a. Total Area = 18.75 A = 0.0293 mi^2

Assume water is 90% of area in B6

b. Assume Starting WS = 758.2

c. El = 758.7 Flow at Normal Depth



Channel slope ≅ .005

$A = 10 \times .7 + 100 \times .7 = 77 ft^2$

$P \cong 210'$

$R = \frac{77}{210} = 0.37$

n = 0.20 for shallow flow

$Q = \frac{1.49}{.2}(77)(.37)^{2/3}(.005)^{1/2} =$

$= 7.45(77)(.515)(.071) = 21$ cfs

d EL = 759.0

Approx =

$A = 10 + 200 = 210 ft^2$

$P = 410'$

$R = \frac{210}{410} = 0.512$

$n = 0.19$

$Q = \frac{1.49}{0.19}(210)(.512)^{2/3}(.005)^{1/2} = 75$ cfs

2. East Quarry

a) Total Area = .04 mi^2

Water Area = 17.32 Ac = .027 mi^2

Water is 68% of area in A6

b) Only outflow is a slight groundwater loss from the gravel pit up to 0.1 cfs or EL = 760.

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT [illegible] Superfund	SHEET NO. 4	OF
ITEM SENSITIVITY ANALYSIS	BY M. Nelson	DATE 1 Apr 96
	CHKD. BY	DATE

1 PEAK & VOLUME COMPUTATIONS, 25-YR STORM

A EAST QUARRY off-CAP Runoff Volume

TIME	A 2	A 5	A6
1230	13	5	
1235	16	5	
1240	19	5	
1245	21	5	
1250	24	4	
1255	26	4	
1300	28	3	
1305	29 +	3 = 32	
1310	30 +	2 = 32	
1315	30	2	
1320	30	2	
1325	30	2	
1330	29	1	

A 3 A 5 A 6

6 + 1 + 6 = 13 AF

A 3 A5 A6

AT 1210 3 + 3 + 97 = 103

B WEST QUARRY

TIME	B_1	B_2	B_3	SUB	B_4	B_5	Sub	B_6	
	off-cap				CAP				
1210	1	0	1	2	49	15	64	29	
1215	2	1	1	4	70 +	10	80	33	
1220	4	1	2	7	74 +	6	80	35	
1225	5	1	2	8	64	4	68	34	
1230	7	2	3	12	51	3		34	
1235	8	2	4	14	40	2		32	
1240	10	2	5	17	31			30	
1245	12	3	5	20	24			28	
1250	13	3	6	22	19			25	
1255	15	4	6	25	15			23	
1300	17	4	7	28	12			21	
1305	19	5	7	31	9			18	49
1310	20	5	7	32				17	49
1315	22	6	8	36				15	51
1320	23	6	8	37				14	51
1325	23	7	8	38				12	50
1330	24	8	8	38				11	49
1335	24	8	8	40				10	50
1340	24	9	8	41				9	50
1345	24	9	8	41				8	
1350	24	10	7	41				8	
1355	24	11	7	42				7	
1400	23	11	7	41				6	
1405	23	12	7	42				6	

Volume

$B_4 = 5$

$B_5 = 1$

6

B_1 = problem

$B_2 = 15$

$B_3 = 2$

17

$B_6 = 6$

21

B. cum B_2 14.5 B_3 2

B_6 55

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO - Superfund	SHEET NO. 5 OF	
ITEM Excavation Analysis	BY M Nelson	DATE 1 Apr 96
	CHKD. BY	DATE

I SUMMARY FOR 25-YR STORM

BASIN	START CONDIT.	Cap Qp	Cap Vol	Exfil Qp	Exfil Vol	Tot Qp	Tot Vol	Peak WS EL	Peak Outfl cfs
East A	Low (1995) 754.0	117	9	32	12.5	129	21.5	755.6	0
East A	High (80s) 756.1	117	9	32	12.5	129	21.5	757.3	0
West B	Low (1995) 755.0	80	6	42	22.0	87	28.0	756.7	0
West B	High (80s) 758.2 with initial flow	80	6	.42	22.0	87	28.0	758.7	22

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO Superfund		SHEET NO.	OF
ITEM Sensitivity Analysis EAST POND AREA		BY M. Nelson	DATE 4 April 9x
		CHKD. BY	DATE

A USING AREAS GROUNDWISED

1. GIVEN:

EL	A
756.0	17 Acres
758	19.5 Ac

2. Result Reaches EL 757.3 Need Less than 757.09 or 757.0

B ITERATE TO A SOLUTION THAT GIVES 757.0 AS MAX WS

Assume same slope on Pond Sides or roughly 2.5 Acre gain from EL 756.0 to 758.0

1. TRY

EL	A		
756.0	20		
758.0	22.5	Reaches 757.1	close

2. TRY

EL	A	
756.0	21.0	
758.0	23.5	Reaches 757.1

3 TRY

EL	A		
756.0	22.0		
758.0	24.5	Reachs 757.0	Can back down

4. TRY

EL	A		
756.0	21.5		
758.0	24.0	Reaches 757.1	Go up

5. TRY

EL	A		
756.0	21.8		
758.0	24.3	Reaches 757.1	Go up

6 TRY

EL	A		
756.0	21.9		
758.0	24.4	Reaches 757.0	USE THIS RUN

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO DUMP - Elkhart, IND	SHEET NO. 1 OF	
ITEM Model Parameters for Kinematic Wave	BY M. Nelson	DATE 13 Mar 96
	CHKD. BY	DATE

I SUBBASINS

A OLD QUARRY DRAINAGE

A-1 : Southeast corner of Cap, upstream of New Road Culvert
A-2 : East Part of Cap
A-3 : Residential Drainage upstream of 30" RCP
A-4 : North Side of Cap
A-5 : Northeast off-site drainage through 15" RCP
A-6 : Old Quarry & Surrounding Drainage

B. WEST BORROW PIT DRAINAGE

B-1 : Northeast off-site drainage through 18" RCP
B-2 : Northern off-site drainage through 18" RCP
B-3 : Northwest off-site drainage through 15" RCP
B-4 : Southern Part of Cap

B-5 : West Side of Cap
B-6 : Borrow Pit & Surrounding Drainage

II SUBBASIN PARAMETERS FROM MAP

A MAP SCALES

1) Quad Map

Linear: 1" = 2,000' or 1:24,000

$$\text{Area: } A = \frac{\text{Area in in}^2}{} \left| \frac{FT^2}{144\ in^2} \right| \frac{mi^2}{(5280\ FT)^2} \left| \frac{(24,000)^2}{1} \right.$$

$$A = 0.1435 * (\text{Area in inches})^2 \text{ miles}^2$$

2) Site Grading Plan

Linear: 1" = 100' or 1:1,200

$$\text{Area: } A = \frac{\text{Area in in}^2}{} \left| \frac{FT^2}{144\ in^2} \right| \frac{mi^2}{(5,280\ FT^2)} \left| \frac{(24,000)^2}{1} \right.$$

$$A = 0.0003587 * (\text{Area in inches})^2$$

3) Map Parameters to Get
a) Area
b) Overland Flow length
c) Overland Slope
d) Channel Lengths
e) Channel Slopes
f) Borrow & Pit Surface Areas

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OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO DUMP - Elkhart, IND		SHEET NO. 2	OF
ITEM		BY M. Nelson	DATE 13 Mar 96
MODEL PARAMETERS FOR KINEMATIC WAVE		CHKD. BY	DATE

IIB SITE GRADING PLAN PARAMETERS

1) Sub A-1 (All Cap)
 a) BA = 16.45 in² = 0.0059 mi² = 3.78 AC
 b) Lovl = 4" = 400' S = 23'/400' = 0.0575
 c) % IMP A = 0
 d) Col Chan L = 5" = 500'
 e) Col Chan S = 1.5'/500' = 0.003
 f) Shape = TRAP
 g) WD = 5' x 2' deep
 h) Z : 0.237" = 23.7' Z = 6'/23.7' = 0.25 or 4:1 side slope

2) Sub A-2 (Mostly Cap)
 a) BA = 28.85 in² = 0.0103 mi² = 6.59 AC
 b) Lovl = 2.67" = 267' S = 26'/267' = 0.097
 c) % IMPA = 10% (ROAD)
 d) Chan L = 10.6" = 1060'
 e) Chan S = 2'/1060' = .0019
 f) Shape = TRAP
 g) Width = 5
 h) Z : 306" = 30.6' Z = 7'/30.6' = 0.228 or 4:1 sideslope

3) Sub A-4 (All Cap)
 a) BA = 100.95 in² = 0.0362 mi² = 23.17 AC A Road Ditch = 4.8 in² = .001722 mi²
 b) Lovl = 5.06 in = S = 32'/506' = .063 S Road Ditch Δh = 15'/467' = .032
 c) % IMPA = 0
 d) Chan L = 6.43" = 643'
 e) Chan S = 0.5'/643' = .00078
 f) Shape = TRIANGLE
 g) Width = 0
 h) Z : 0.483" = 48.3' Z = 1'/48.3' = .021 Inv = 48

4) Sub A-6 (QUARRY) 25.79 AC * Assume Future Excavations
 a) BA = 112.4 in² = 0.0403 mi²
 b) Water A(754) = 51.19 in² = 0.0184 mi² (462) 11.78 AC A(760) 73.51 in² = 0.0264 mi² 16.90 AC
 c) Lovl = 3.25 in = 325' S = 4'/325' = .0123
 d) % IMPA = 51.19/112.4 * 100% = 45.5%
 e) Chan L = 7.36" 736'
 f) Chan S = 2'/736' = .0027
 g) Shape TRIANGLE
 h) Width 0
 i) Z : .982" = 98.2' Z = 2'/98.2' = .020

 j) Present Pit areas A(754) = 39.9 in² = 9.16 AC
 A(760) = 73.2 in² = 16.8 AC

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO DUMP - Elkhart, IND		SHEET NO. 3	OF
ITEM MODEL PARAMETERS		BY M. Nelson	DATE 13 Mar 96
		CHKD. BY	DATE

II.B SITE GRADING PLAN PARAMETERS

1) Sub B-4 (All Cap)
a) BA = 79.9 in² = 0.0287 mi² = 18.37 Ac
b) Lovl = 4.09" = 409' S = 24'/409' = .058
c) % IMPA = 1% (Road)
d) Col Chan L = 15.6" = 1560'
e) Col Chan S = 4'/1560' = .0026
f) Shape = TRAP
g) WD = 5'
h) Z : .210 Z = 5'/21.0' = .238 4:1 sideslope

2) Sub B-5 (All Cap)
a) BA = 9.81 in² = 0.0035 mi² = 2.24 Ac
b) Lovl = 2.28" = 228' S = 22'/228' = .096
c) % IMPA 1%
d) Col Chan L
e) Col Chan S
f) Shape =
g) WD =
h) Z =

No Col Chan

3) Sub B-6 (BORROW AREA) — * Assume future excavations —
a) BA = 78.6 in² = 0.0282 mi² = 18.05 Ac
b) Water A(755) = 45.5 in² = 0.0163 mi² = 10.4 Ac A(759) = 53.7 in² = 0.0192 mi² = 12.33 Ac
c) Lovl = 1" = 100' S = 2'/100' = .02
d) % IMP = WATER = 45.5/78.6 * 100% = 58%
e) Chan L = 6.16" = 616'
f) Chan S = 1.5'/616' = .0024
g) Shape = TRIANGLE
h) Width = 0
i) Z : 0.59" Z = 1.25'/59' = .021

J. Present PIT AREAS A(755) 6.1 + 2.01 = 8.11 in² = 1.86 Ac
A(759) = 41.8 in² = 9.59 Ac

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO DUMP - Elkhart, IND	SHEET NO. 4	OF
ITEM Model Parameters for Kinematic W.	BY M. Nelson	DATE 13 MAR 96
	CHKD. BY	DATE

QUAD MAP PARAMETERS

1) Sub A-3
   a) BA = 0.550 in² = 0.0789 mi² ≈ 0.079 mi² = 50.56 Ac
   b) Overland flow length = 300'
   c) Overland flow, Slope = 2/300 = 0.0067
   d) Collector Channel Length = 1.461 in = 2,922'
   e) Collector Channel Slope = (775 - 762)/2,922 = 0.0044
   f) IMPA = 15 to 20%
2) Sub A-5
   a) BA = 0.070 in² = 0.010 mi² = 6.4 Ac
   b) Lo = 300'
   c) S = 2/300 = 0.0067
   d) Col L = 0.200 in = 400'
   e) Col S = (775 - 770)/400' = 0.0125
   f) IMPA = 15 to 20%
3) Sub B-1
   a) BA = 1.197 in² = 0.1718 mi² ~ 0.172 mi² = 110.1 Ac
   b) Lo = 300'
   c) S = 5/300' = 0.017
   d) Col L = 1.250 in = 2,500'
   e) Col S = (775 - 767)/2,500' = 0.0032
   f) IMPA = 5 to 10%
4) Sub B-2
   a) BA = 2.03 in² = 0.2913 mi² ~ 0.291 mi² = 186.24 Ac
   b) Lo = 300'
   c) S = 3/300 0.010
   d) Col L = 2.739 in = 5,478'
   e) Col S = (776 - 763)/5,478 = 0.0024
   f) IMPA = 1 - 5%
5) Sub B-3
   a) BA = 0.304 in² = 0.0443 mi² ~ 0.044 mi² = 28.16 Ac
   b) Lo = 300'
   c) S = 2/300 = 0.0067
   d) Col L = 0.764 in = 1,528'
   e) Col S = (767 - 763)/1,528' = 0.0026
   f) IMPA = 1 - 5%

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO DUMP - Elkhart, IND		SHEET NO. 5	OF
ITEM Model Parameters for Kinematic Wave		BY M. Nelson	DATE 11 Mar 96
		CHKD. BY	DATE

III HEC-1 MODEL PARAMETERS NEEDED

A LU RECORD "Loss Rate Data"

For Cap

1) STRTL = Initial loss in inches (for pervious Area) (0.1")

2) CNSTL = Uniform rainfall loss in inches/hr (") (0.05 iph)

3) RTIMP = % of Basin that is impervious (") (0)

4-6 Rates for impervious area

B UK RECORD "Kinematic Overland Flow"

1) L = Overland Flow Length in Ft (Max = 300')

2) S = Representative Slope (ft/ft)

3) n = Roughness Coeff for overland Flow (0.4)

4) A = % of subbasin area Represented by element

C RK Record "Collector Kinematic Wave"

1) L = Channel Length

2) S = Channel Slope

3) n = Channel Roughness (.045)

4) CA = Contributing area

5) Shape = Trapezoidal for this project

6) WD = Channel Bottom width - from plans

7) Z = Side slopes - from plans

Note CA = (Overland Flow Length) * (Subbasin Area) / Length of main channel = CL * OFL * 2

D RD Record "Collector Kinematic Wave

1) L = Channel length

2) S = Channel Slope

3) n = Channel Roughness

4) CA = leave blank

5) Shape = Trapezoidal

6) WD = Channel bottom width

7) Z = Channel Side slopes

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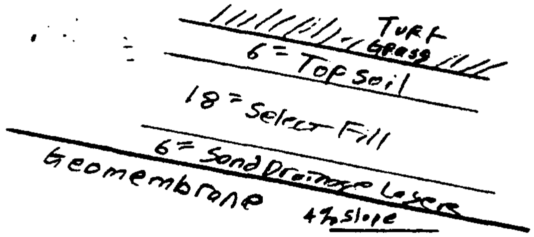
OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO DUMP - Elkhart, IND	SHEET NO. 6	OF
ITEM Model Parameters for Kinematic W.	BY M. Nelson	DATE 11 Mar 96
	CHKD. BY	DATE

PARAMETERS FROM OTHER INFO

A Cap Characteristics (Design)



Cover Aprox 58 acre landfill
Groundwater Table 752 to 756'

LU Record:
Use Initial Loss (STRTL) = 0.1" To grass
Use CNSTL loss (CNSTL) = 0.05 /ph (Assume nearly saturated starting condit.)
RTIMP = 1% (minimum)

UK Record:
Mannings n for cap = 0.40 overland flow through turf

RD Record:
Mannings n for channels = 0.045 grassed waterway, Turf grass

B OFF SITE SUBBASINS from Quad & Highway INFO
1) Channel Shape assume Trapezoidal

2) Side slopes assume 1:1

3) Width - Determine Culvert capacity & match channel size
Use Concrete Design Manual Nomographs. Assume Outlet Control
Assume $n = 0.06$

4) Sub A-3 (30" RCP) AHW = 4'
$L = 400'$ $HW + S_0L = 3.6'$ for $Q = 20$ cfs

TRY 1:1 d W 1:1 TRY $d=2, W=3$ $A = 6+4 = 10\ FT^2$ $P = 3+2\sqrt{2} = 5.83$
$R = 10/5.83 = 1.72'$

$Q = \frac{1.49}{.06}(10)(1.72)^{2/3}(0.0044)^{1/2} = 23.65 \simeq 20$ cfs

SO $WD = 3'$
$Z = 1$

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO DUMP – Elkhart, IND		SHEET NO. 7	OF
ITEM Model Parameters for Kinematic Wave		BY M. Nelson	DATE 14 Mar 96
		CHKD. BY	DATE

IV B OFF-SITE SUBBASINS

3) Channel Widths

b) Sub A-5 (15" RCP) AHW = 3'

L = 200' $HW + S_oL = 2.4$ for Q = 5 cfs

TRY 1:1 _2_/ 1:1 TRY d = 1.5, w = 2 $A = (2\times1.5) + 2(1.5)^2 = 5.25\ FT^2$

$P = 2 + 2\sqrt{1.5^2+1.5^2} = 6.24'$

$R = A/P = 5.25/6.24 = 0.84'$

$Q = \frac{1.49}{0.06}(5.25)(0.84)^{2/3}(.0125)^{1/2} = 13$ cfs

TRY d = 1, w = 2 $A = 2 + 1 = 3$

$P = 2 + 2\sqrt{2} = 4.83'$

$R = A/P = 3/4.83 = 0.62'$

$Q = \frac{1.49}{0.06}(3)(.62)^{2/3}(.0125)^{1/2} = 6$ cfs

So USE WD = 2

Z = 1

c) Sub B-1 (24" RCP) 58 Get it down to 20-25

L = 75' AHW = 3' Q = 18.5 cfs

Similar slope to Sub A-3

USE WD = 3'

Z = 1

d) Sub B-2 (18" RCP)

L = 75' AHW = 3' Q = 12 cfs 60 get down to 15-20

TRY d = 2, w = 2 $A = 4 + 4 = 8\ FT^2$ $R = A/P = 8/7.66$

$P = 2 + 2\sqrt{2^2+2^2} = 7.66'$ $R = 1.04'$

$Q = \frac{1.49}{0.06}(8)(1.04)^{2/3}(.0024)^{1/2} = 10$ cfs

USE WD = 2.5'

Z = 1

e Sub B-3 (18" RCP)

USE WD = 2

Z = 1

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U.S.G.P.O. 1995-657-136

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO DUMP - Elkhart, IND		SHEET NO. 8 OF
ITEM Model Parameters for Kinematic Wave		BY M. Nelson DATE 15 Mar 96
		CHKD. BY DATE

✓ OFF-SITE SUBBASINS

A Assumptions:

1) The culverts under the expressway to the northwest will handle a 50 YR event without overtopping the road.

2) The allowable headwater at those culverts is 4'

3) Any hydrograph generated upstream of the culverts must not exceed 1.5 times culvert capacity (Remainder of flow is ponded upstream of the culvert)

B Road Culverts [From Call to Scott May Elkhart, IND Engineer Dept.] Phone (219-293-2572)

SUBBASIN	CULVERT
A-3	30" RCP
A-5	18" RCP
B-1	24" RCP
B-2	18". RCP
B-3	18" RCP

C Soil Type

1) From USGS Equations:
Region is Zone A with the lowest runoff coefficient in state
This means highest loss rates.

2) From 30% Design Analysis
a) Landfill & surrounding areas are marshlands
b) Water table is high and unconfined in permeable sands and gravels
c) Sand and gravel were quarried on the site

D Starting Values

1) LU	STRTL	CNSTL	RTIMP
	0.3 in	2.5 iph	1-15%

2) UK/RD: Gently sloping forest and cropland with some intermediate ... defined channels to concentrated overland flow
Storm sewering minimal
Overland n 0.17 to 0.8 Table 3.5 HEC - Manual
Channel n 0.4 to 0.5

OMAHA DISTRICT — COMPUTATION SHEET — CORPS OF ENGINEERS

PROJECT HIMCO

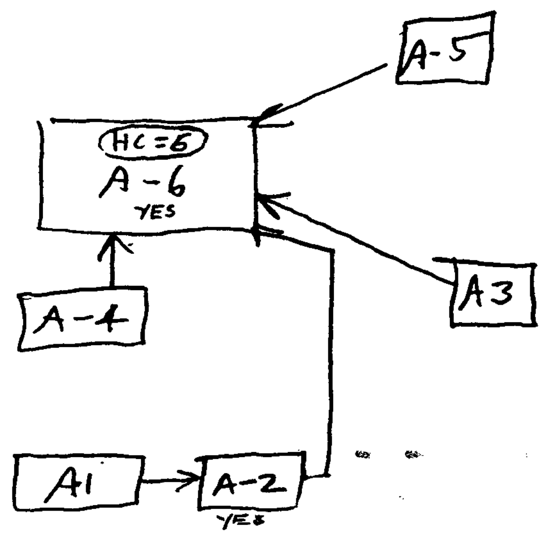
SHEET NO. 9 OF

ITEM HEC-1 ROUTING

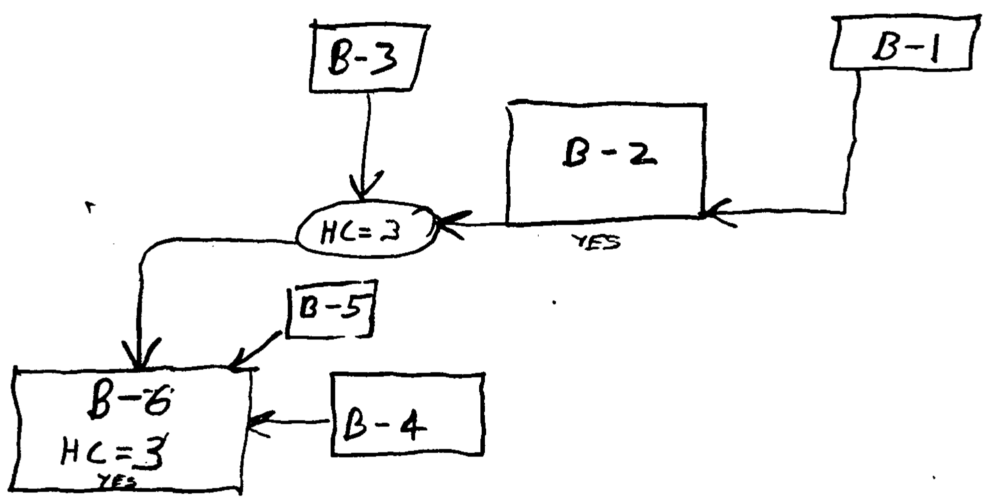
BY M. Nelson DATE 13 MAR 96

CHKD. BY DATE

PART A QUARRY



PART B - BORROW AREA



OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO DUMP - Elkhart, INDIANA	SHEET NO. 10 OF	
ITEM	BY M. Nelson	DATE 19 Mar 96
Kinematic Wave Results	CHKD. BY	DATE

HEC-1 ANALYSIS

A Peak Discharges by Subbasin or Location

Subbasin or Location		Qp cfs
	Peak into Gravel Pit =	203
A-1	SE Part of Landfill Cap	17
A-2	E Part of Landfill Cap	38
A-3	Off-site residential area to the East via 30" RCP	310
A-4	N Part of Landfill Cap	78
A-5	Off-site Woodland draining in via 18" RCP	5
A-6	Gravel quarry and Water Surface	97
B-1	Off-site Woodland & housing area via 24" RCP	24
B-2	Off-site Woodland, cropland & airport via 18" RCP	22
B-3	Off-site cropland via 18" RCP	8
B-4	S Part of landfill Cap	74
B-5	W Part of landfill Cap	15
B-6	Borrow area and Water Surface	23

B Peak "Q" Generated by Cap

Time	A-1	M.K.	A-2		A-4		B-4	M.K.	B-5		Σ
1200	4	(4)	8	(6)	16		14	(12)	5		
1205	9	(7)	15	(13)	29		27	(27)	9		
1210	15	(15)	28	(26)	52		52	(49)	15		
1215	17	(17)	38	(36)	72	(125)	73	(70)	10	(180)	205
1220	15	(15)	39	(38)	78	(131)	75	(74)	6	(80)	211 cfs
1225	11	(11)	35	(35)	74		64	(64)	4		
1230	8	(9)	29	(29)	65		50	(51)	3		
1235	6	(7)	23	(23)	55		37	(40)	2		
1240	5	(5)	18	(19)	46		30		2		
1245	4		14	(15)	37		23		1		

$\underbrace{\text{A-1, A-2, A-4}}_{}$ Qp = 186 cfs at 12:17, Group $A_1 - A_6$

$\underbrace{\text{B-4, B-5}}_{}$ Qp = 106 at 12:25, Group $B_1 - B_6$

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO Dump - Elkhart, IND	SHEET NO. 11	OF
ITEM Kinematic Wave Results	BY M. Nelson	DATE 19 Mar 96
	CHKD. BY	DATE

V C Volume

1) Volume from Landfill Cap

Subbasin	Vol Acre Ft
A-1	1
A-2	2 (3-1)
A-4	6
Subtotal	$\boxed{9}$
B-4	5
B-5	1
Subtotal	$\boxed{6}$
TOTAL	$\boxed{15}$

2) Volume from Off-Site

Subbasin	Vol Acre Ft
A-3	6
A-5	1
B-1	7
B-2	8 (15-7)
B-3	2
TOTAL	$\boxed{24}$

TOTAL Volume GENERATED
= 9 + 6 + 24 + 9 = 48 Acre FT

3) Volume from Gravel QUARRY & Borrow Area

A-6	5
B-6	4
	$\boxed{9}$

4) TOTAL STORM Runoff Volume STORED ON SITE

SUBBASINS	Volume AF
GROUP A	20.2
GROUP B	26.5
TOTAL	46.7 ~ 47 ACRE FT

North & East Basin Volumes = 9 + 7 + 5 = 21 AF
Northwest Basin Volumes = 6 + 17 + 4 = 27 AF

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT Himco Dump – Elkhart, IND	SHEET NO.	OF
ITEM Water Supply	BY M. Nelson	DATE 19 Mar 95
	CHKD. BY	DATE

VI Mean Annual Volume of Runoff

A. Mean Annual Precipitation = 36 inches for Elkhart, IND

B. ASSUMPTIONS

Assume 90% of Rain Falling on Cap Runs Off

1. Light events will evaporate before running off
2. Some of the snow will evaporate or sublimate before running off

Assume that 2-10% of Off Site Rain Runs off

Assume that 100% of precip falling on ponds runs off but 34/36 is lost to EVAPORATION Evap = 34"

Assume that 75% of precip falling on areas around ponds runoff.

C. VOLUMETRIC COMPUTATIONS AVG ANNUAL WATER YIELD

SUBBASIN	AREA (AC)	PRECIP V. (AC-FT)	FACTOR	R.O. Vol. (AC-FT)
A-1 c	3.78	11.3	.9	10.2
A-2 c	6.59	19.8	.9	17.8
A-3	50.56	151.7	.10	15.2
A-4 c	23.17	69.5	.9	62.6
A-5	6.40	19.2	.02	0.4
A-6 I	14.34	43.0	.06	2.6
A-6 Land	11.45	34.4	.75	25.8
B-1	110.10	330.3	.02	6.6
B-2	186.20	558.6	.01	5.6
B-3	28.16	84.5	.01	0.8
B-4 c	18.37	55.1	.9	49.6
B-5 c	2.24	6.7	.9	6.0
B-6 I	11.36	34.1	.06	2.0
B-6 Land	6.68	20.0	.75	15.0

TOTAL = 220.2 ACRE-FT

FROM CAP = 146.2 AF
FROM OFF-SITE = 28.6 AF
FROM BORROW AREAS = 45.4 AF

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO DUMP - Element INC	SHEET NO.	OF
ITEM SUMMARY & CONCLUSIONS	BY M Nelson	DATE 2-Mar-96
	CHKD. BY	DATE

III GROUND WATER CONSIDERATIONS

A. Water Table on 16 Sep 95
1) GRAVEL Pit (A6) = 753.5
2) Borrow Area (B6) = 755.1

B. Hydraulic Conductivities Horizontal
1) Average = 0.0022 cm/sec
2) Range = 0.00079 cm/sec - 0.0022 cm/sec

C. HISTORIC RANGE 1980-1989 has fluctuated 4 to 6 feet
1) Readings (where well identified) for 16 Sep 95

Well	16 Sep 95	Mean	Min	MAX
B2	754.75	756.27	754.23	759.23

Note that this well read 1.5' below its historic mean and 4.48' below its historic maximum.

D. Vertical Gradients are predominately upward.

E. GROUND WATER BALANCE (ANNUAL)
1) Assume Ponds provide an average 0.5' high mound
2) Pond Perimeters
Gravel Pit (A6) 34×100' = 3400'
Borrow Pit (B6) 32×100' = 3200'
3) Ground WATER Movement AREA

$$A = 0.5' \times (3400' + 3200') = 3300 \text{ FT}^2$$

4) Average Groundwater Capacity OUT:

$$V = \frac{0.0022 \text{ cm}}{\text{sec}} \left| \frac{\text{in}}{2.54 \text{cm}} \right| \frac{\text{FT}}{12 \text{in}} \left| \frac{86400 \text{sec}}{\text{DAY}} \right| \frac{365 \text{DAY}}{\text{YR}} \left| 3300 \text{FT}^2 \right.$$

$$V = 751{,}528 \text{ FT}^3 = 172 \text{ ACRE FT OUT}$$

5) Average Volume to get Rid of = 220 ACRE FT

∴ May not be able to get Rid of Pond inflow in an average Year

ELEVATION OF 30" RCP INLET INVERT EL = 757.09
OUTLET INVERT EL = 755.95

START POOL = 754.0 25-YR POOL = 755.4 50-YR POOL = 755.7

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2-&50
ditches Culvr

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO DUMP - Elkhart, Indiana	SHEET NO.	OF
ITEM	BY M.Nelson	DATE 8 Mar 96
Rainfall Probability	CHKD. BY	DATE

I GIVEN
A 25-Year Event for Ditches & Surveylonio
B 50-YEAR EVENT FOR MAJOR ROAD CULVERTS
C LOOK AT DURATIONS FROM 15 min TO 6 HRS

II HYDRO-35 (5-60 minute Durations) At Elkhart, IND
A Map Data From Figures 4-9

FREQ	DURATION	RAINFALL
2-YR	5 min	.42
100-YR	5 min	.78
2-YR	15 min	.84
100-YR	15 min	1.60
2-YR	60 min	1.4
100-YR	60 min	3.0

B Durations Required for PH Card (5m, 15m, 60m, 2h, 3h, 6h)

C Compute 25 & 50-YR intensities
(1) 25-YR 0.669 (100-YR) + 0.293 (2-YR)
a) 5-minute 0.669 (.78) + .293 (.42) = 0.64
b) 15-min 0.669 (1.60) + .293 (.84) = 1.32
c) 60-min 0.669 (3.0) + .293 (1.4) = 2.41

(2) 50-YR 0.835 (100-YR) + 0.146 (2-YR)
a) 5-minute 0.835 (.78) + 0.146 (0.42) = 0.71
b) 15-minute 0.835 (1.6) + 0.146 (.84) = 1.45
c) 60-minute 0.835 (3.0) + 0.146 (1.4) = 2.71

III POINT RAINFALL FROM TP-40

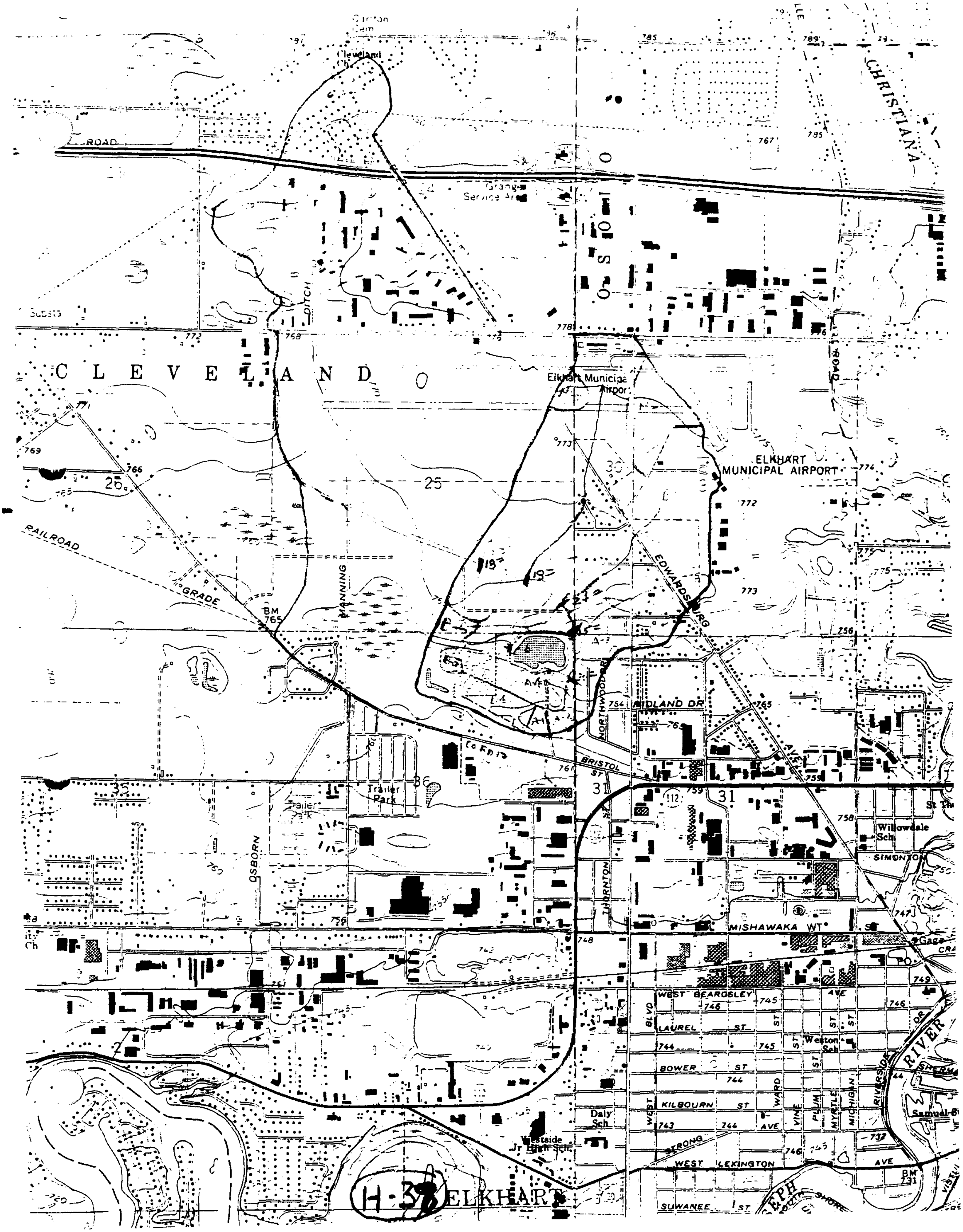
DUR \ FREQ	25-YR	50-YR
1-HR	2.20	2.40
2-HR	2.60	2.85
3-HR	2.80	3.10
6-HR	3.30	3.70
12-HR	3.80	

* Note 25-YR, 24 HR Rainfall is = 4.5 inches VOLUME REQ'D (INDIANA REGISTER)

Weather Stations Nearby:
Goshen, College, IN - Hourly
South Bend WSO, IN - Hourly
White Pigeon, MI - 24 HR

IV PH CARDS

ID	PFREQ	TRSDA	5-min	15-min	60-min	2HR	3HR	6HR	
PH	–	–	0.64	1.32	2.41	2.60	2.80	3.30	25-YR
PH	–	–	0.71	1.45	2.71	2.85	3.10	3.70	50-YR

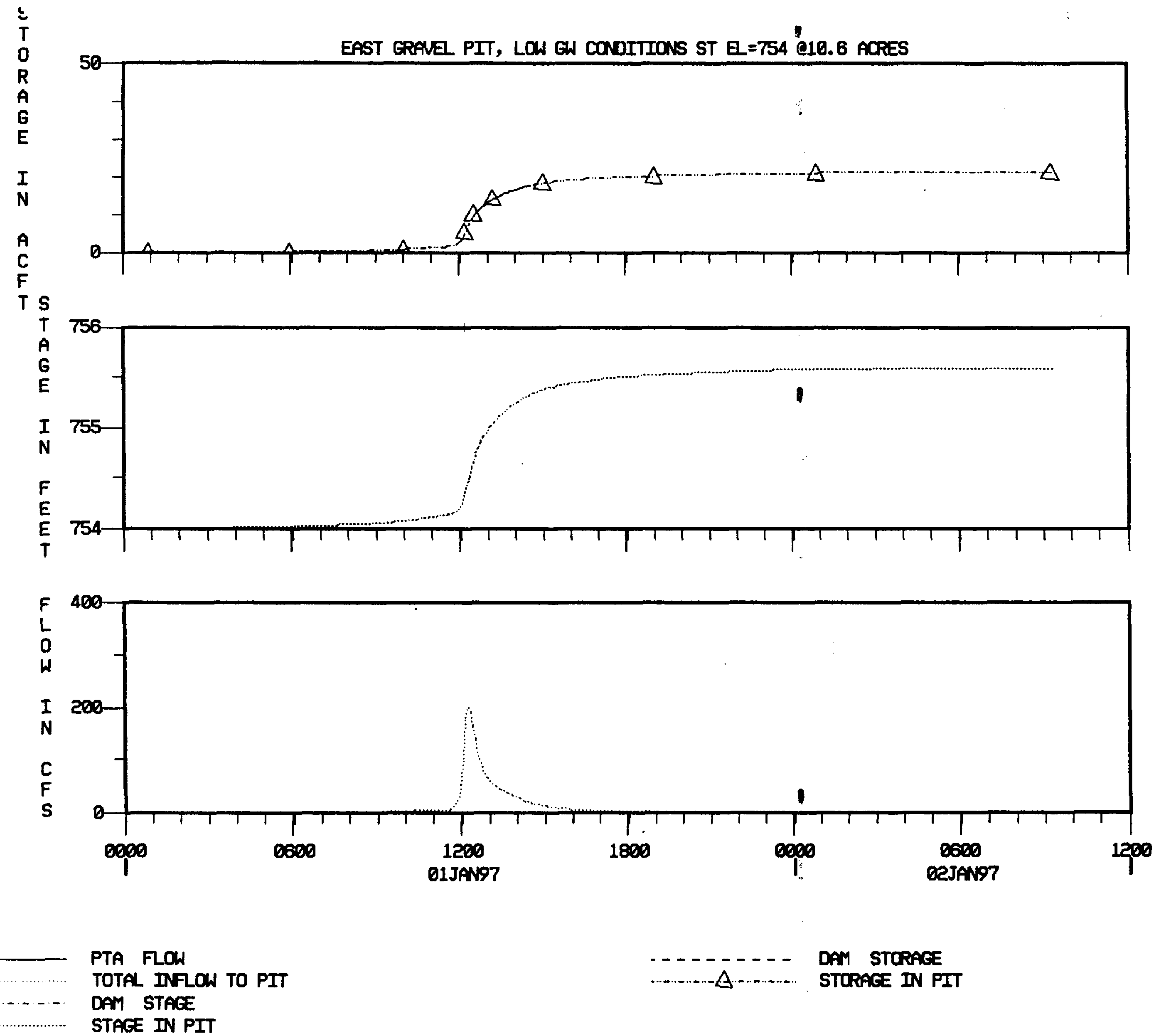


Cleveland Ch
ROAD
Grange Service Area
CHRISTIANA
CLEVELAND
DITCH
Elkhart Municipal Airport
ELKHART MUNICIPAL AIRPORT
RAILROAD GRADE
MANNING
EDWARDSBURG
MIDLAND DR
NORTHWOOD DR
BRISTOL ST
Trailer Park
OSBORN
THORNTON
Willowdale Sch
SIMONTON
MISHAWAKA
WEST BEARDSLEY AVE
LAUREL ST
BOWER ST
KILBOURN ST
STRONG AVE
WEST LEXINGTON AVE
SUWANEE ST
Weston Sch
Daly Sch
Westside Jr High Sch
WEST BLVD
WARD
VINE
PLUM
MYRTLE
MICHIGAN
RIVERSIDE DR
RIVER
ST JOSEPH
ELKHART
H-39

```
ID ELKHART, INDIANA
ID HIMCO DUMP SUPERFUND SITE
ID SOUTH & WEST PORTION, CAP AND OFF SITE DRAINAGE
ID INFLOW TO WEST BORROW AREA, 1 APRIL DIMENSIONS
ID KINEMATIC WAVE ROUTING
ID M.E. NELSON
ID US ARMY CORPS OF ENGINEERS
ID APR 1996
ID HIGH WATER TABLE, ASSUME START WS AT 758.3 WITH FLOW TO WEST
ID MUSKINGUM-CUNGE IN CAP CHANNELS
ID 25-YEAR RAINSTORM
*DIAGRAM
*
IT     5 01JAN97    0005      400
IO     1
*
KK    B1
KM NORTHEAST DRAINAGE THROUGH 24" CMP UNDER NAPONEE STREET EXTENSION
PH                  0.64    1.32    2.41    2.60    2.80    3.30    3.80    4.50
LU  0.30    3.00       5
BA 0.172
UK   300    .017    .700     100
RD  2500  0.0032    .500              TRAP       3       1      NO
ZW A=NORTHEAST OFFSITE C=FLOW
*
KK    B2
KM NORTH DRAINAGE THROUGH 18" CMP UNDER NAPONEE STREET EXTENSION
LU  0.30    3.25       3
BA 0.291
UK   300   0.010    .700     100
RD  5478  0.0024    .600              TRAP     2.5       1     YES
ZW A=NORTH OFF SITE C=FLOW
*
KK    B3
KM NORTHWEST DRAINAGE THROUGH 18" CMP UNDER NAPONEE STREET EXTENSION
BA  .044
LU  0.30    2.50       2
UK   300  0.0067    .600     100
RD  1528  0.0026    .200              TRAP       2       1      NO
ZW A=NORTHWEST OFF SITE C=FLOW
*
KK   PTB
KM COMBINE RUNOFF FROM NORTHERN OFFSITE DRAINAGES
HC     2
ZW A=OFFSITE COMBO C=FLOW
*
KK    B4
KM SOUTH SIDE OF CAP
BA .0287
LU   0.1    0.05       1
UK   300   0.058    .400     100
RD                                                              NO
RC    .1    .045      .1    1560   .0026
RX  1002    1006    1010    1026    1031    1047    1051    1055
RY    12      11      10       6       6      10      11      12
ZW A=SOUTH CAP C=FLOW
*
KK    B5
KM WEST SIDE OF CAP
BA .0035
UK   300   0.096    .155     100
RD    20     .01     .04              TRAP       1     100      NO
ZW A=WEST   C=FLOW
```

H-39

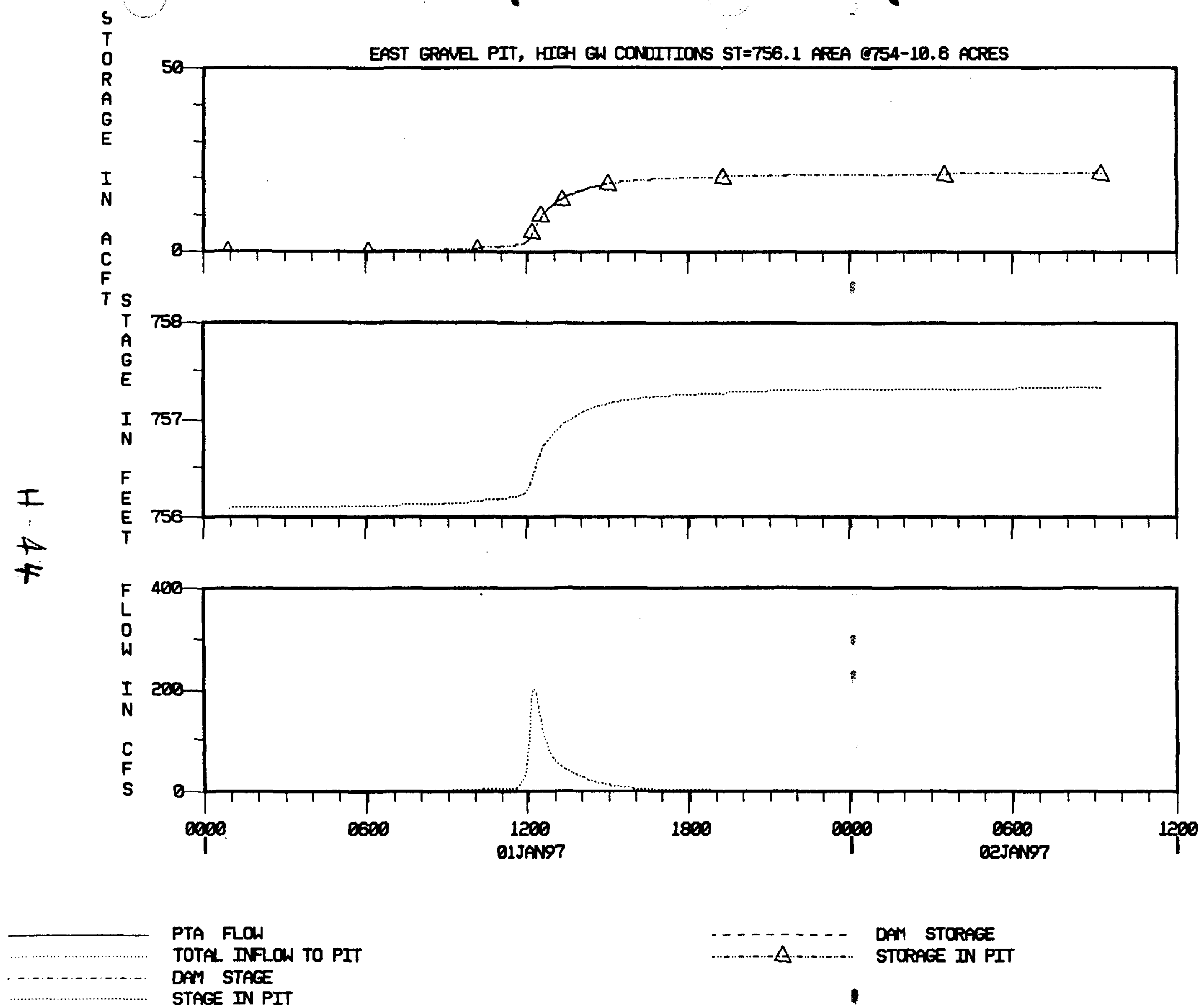
```
*
KK    B6
KM WEST BORROW PIT
BA .0282
LU   .30    5.00      1       0       0      100
UK   300    0.02    .400      10
UK   300   0.300    .050      90
RD   616  0.0024    .400            TRAP       1       50       NO
ZW A=WEST BORROW PIT C=FLOW
*
KK   PTC
KM COMBINED INFLOW INTO WEST BORROW PIT
HC      4
ZW A=INBORROW C=FLOW
*
KK DAM
KM BORROW PIT ACTING AS A RESERVOIR
RS      1     STOR
SA 18.75    19.61
SE 758.2    759.0
SQ     0       21       75
SE 758.2    758.7   759.0
ZW A=BORROW PIT C=STORAGE
ZW A=BORROW PIT C=STAGE
ZW A=BORROW PIT C=FLOW
*
ZZ
```


EAST GRAVEL PIT, LOW GW CONDITIONS ST EL=754 @10.6 ACRES
STORAGE IN ACFT
50
0
STAGE IN FEET
756
755
754
FLOW IN CFS
400
200
0
0000
0600
1200
1800
0000
0600
1200
01JAN97
02JAN97
PTA FLOW
TOTAL INFLOW TO PIT
DAM STAGE
STAGE IN PIT
DAM STORAGE
STORAGE IN PIT

```
ID ELKHART, INDIANA
ID HIMCO DUMP SUPERFUND SITE
ID EAST AND NORTH PORTION, CAP AND OFF SITE DRAINAGE
ID INFLOW TO EAST QUARRY USING 1 APRIL DIMENSIONS
ID KINEMATIC WAVE ROUTING WITH MUSKINGKUM-CUNGE CAP CHANNEL ROUTING
ID M.E. NELSON
ID US ARMY CORPS OF ENGINEERS
ID APR 1996
ID HIGH WATER TABLE, ASSUME START WS AT 756.1
ID 25-YEAR RAINSTORM
*DIAGRAM
*
IT      5 01JAN97    0005      400
IO      1
*
KK     A1
KM SOUTHEAST PORTION OF CAP UPSTREAM OF ACCESS ROAD CULVERT
PH                 0.64     1.32     2.41     2.60     2.80     3.30     3.80     4.50
LU  0.10     0.05        0
BA .0059
UK   300     .058     .400      100
RD                                                              NO
RC    .1     .045       .1      500     .003
RX  1002     1006     1010     1026     1031     1047     1051     1055
RY    12       11       10        6        6       10       11       12
ZW A=CAP UPSTREAM OF CULVERT C=FLOW
*
KK     A2
KM EAST PORTION OF CAP AND ROAD DITCH
LU  0.10     0.05       10
BA 0.010
UK   267    0.097     .400      100
RD                                                             YES
RC    .1     .045       .1     1060    .0019
RX  1002     1006     1010     1026     1031     1047     1051     1055
RY    12       11       10        6        6       10       11       12
ZW A=EAST CAP C=FLOW
*
KK     A3
KM EAST OFFSITE AREA UPSTREAM OF 30" RCP
LU  0.30     2.50       15
BA 0.100
UK   300  0.0067     .600      100
RD  2920  0.0044     .200               TRAP        3        1
ZW A=EAST OFF SITE ABOVE 30 CULVERT C=FLOW
*
KK     A4
KM RUNOFF FROM NORTH SIDE OF CAP
LU   0.1     0.05      0.0
BA .0362
UK   300    0.063     .400      100
RD   643    .0008     .045              TRAP        0       50
ZW A=NORTH CAP C=FLOW
*
KK     A5
KM RUNOFF FROM SMALL NORTH EAST OFF SITE THROUGH 15" RCP
LU  0.30     2.50       15
BA  0.01
UK   300  0.0067      .400      100
RD   400  0.0125      .045              TRAP        2        1
ZW A=NORTHEAST OFFSITE C=FLOW
*
KK     A6
```

```
KM QUARRY AND IMMEDIATE SURROUNDINGS
LU  0.30     5.00        1        0        0      100
BA 0.040
UK   300   0.040     .400       32
UK   300    .300     .050       68
RD   736  0.0027     .060                TRAP        0       50
ZW A=QUARRY C=FLOW
*
KK   PTA
KM COMBINE RUNOFF FROM APT & NCAP AS FLOW INTO GRAVEL PIT
HC     5
ZW A=INPIT C=FLOW
*
KK   DAM
KM QUARRY ACTING AS A RESERVOIR
RS      1     STOR
SA 16.55   17.52    18.60
SE 756.1     757      758
SQ    .0      .1
SE   754     760
ZW A=QUARRY C=STORAGE
ZW A=QUARRY C=STAGE
ZW A=QUARRY C=FLOW
*
ZZ
```

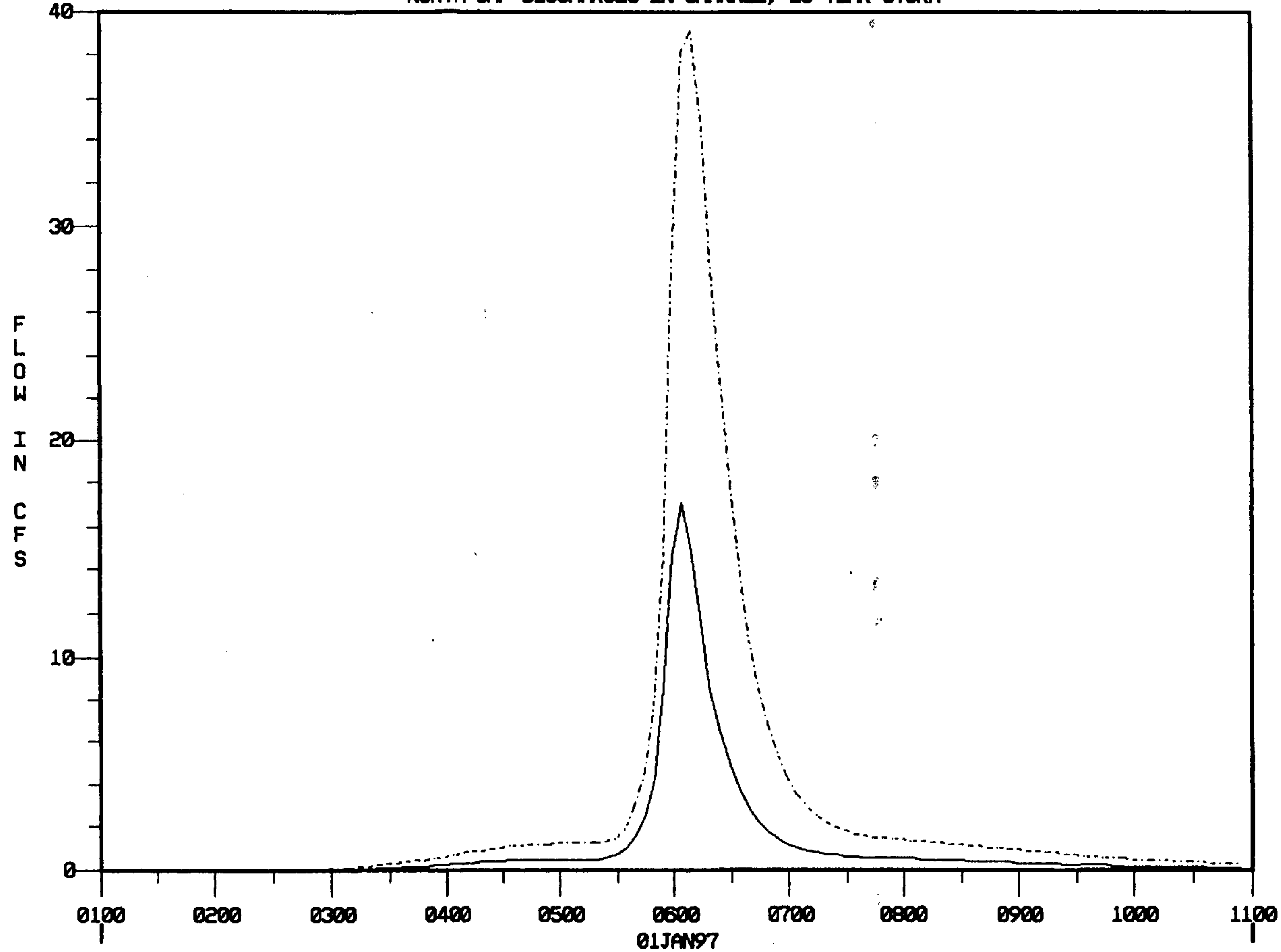
03APR96 ?:23



H-44

H-45

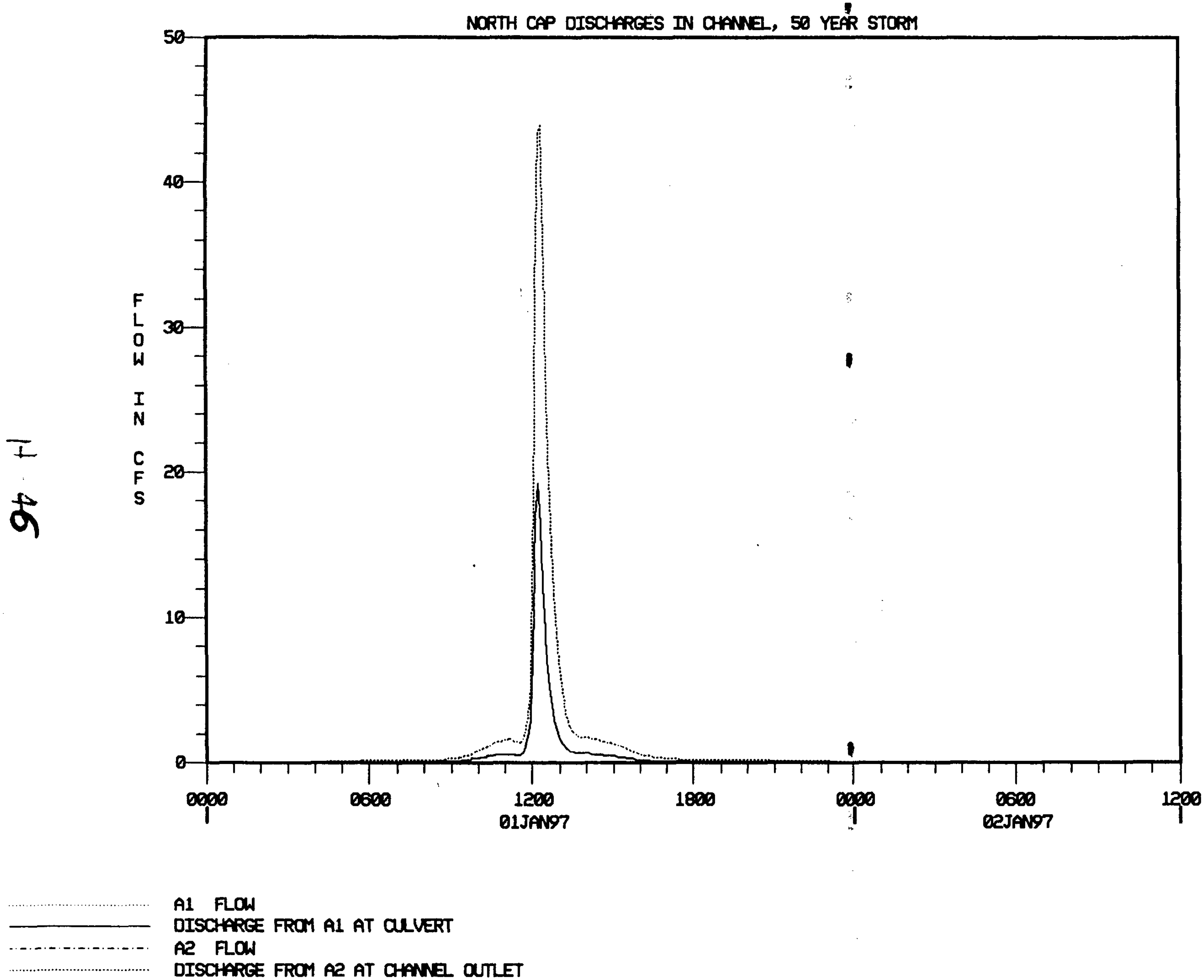
NORTH CAP DISCHARGES IN CHANNEL, 25 YEAR STORM



DISCHARGE FROM A1 AT CULVERT

DISCHARGE FROM A2 AT CHANNEL OUTLET

18MAR96 15:20



H-46

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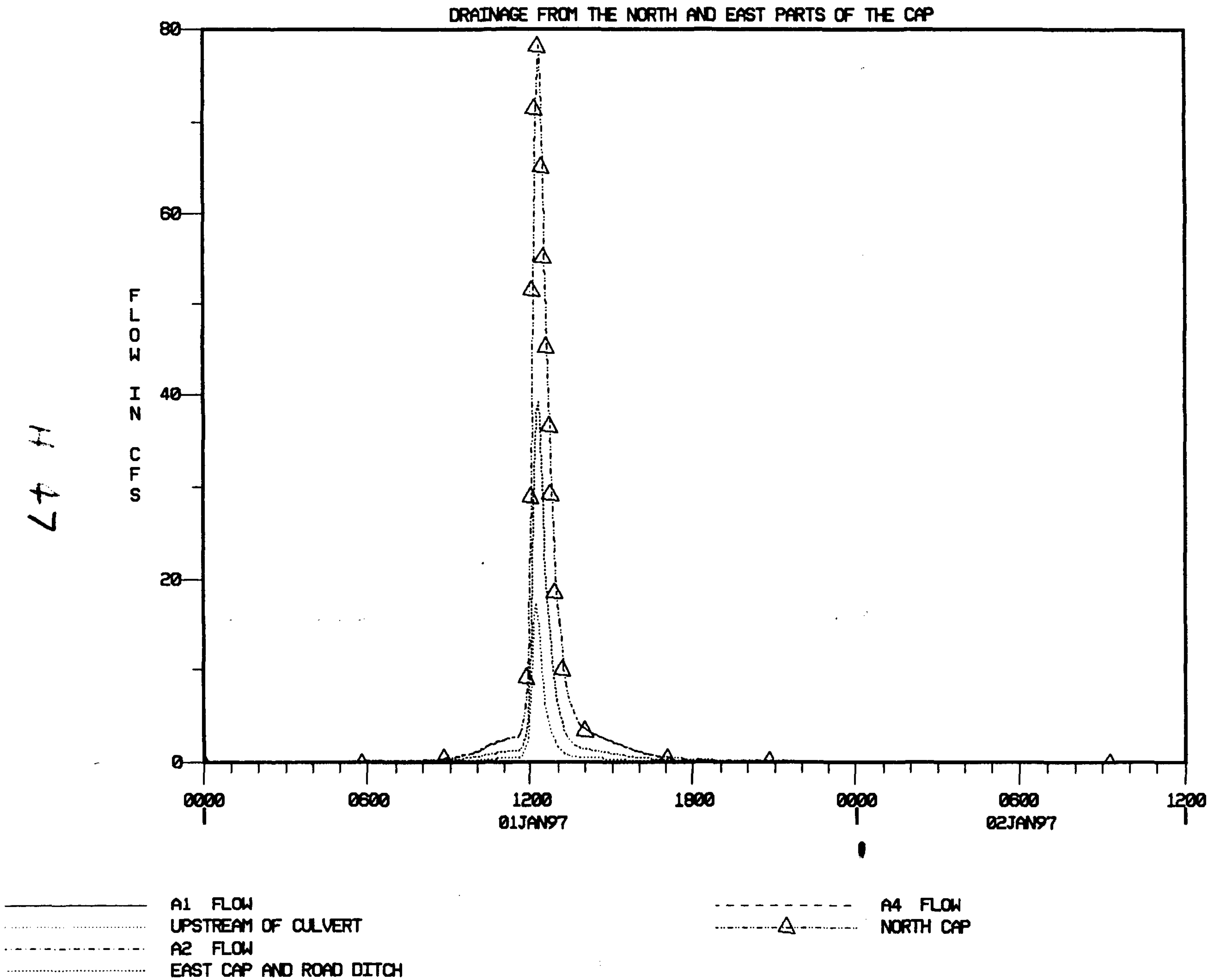

H 47

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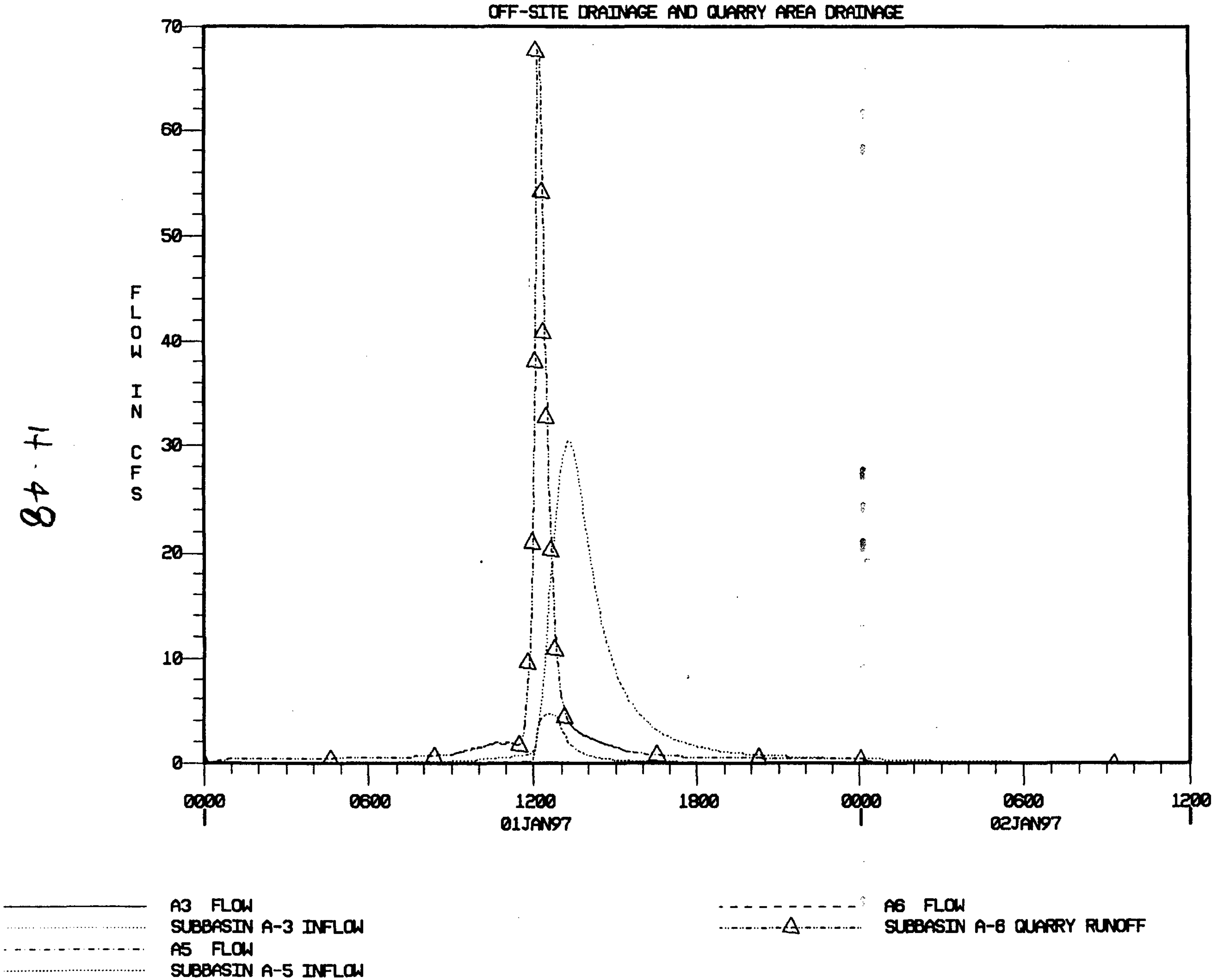
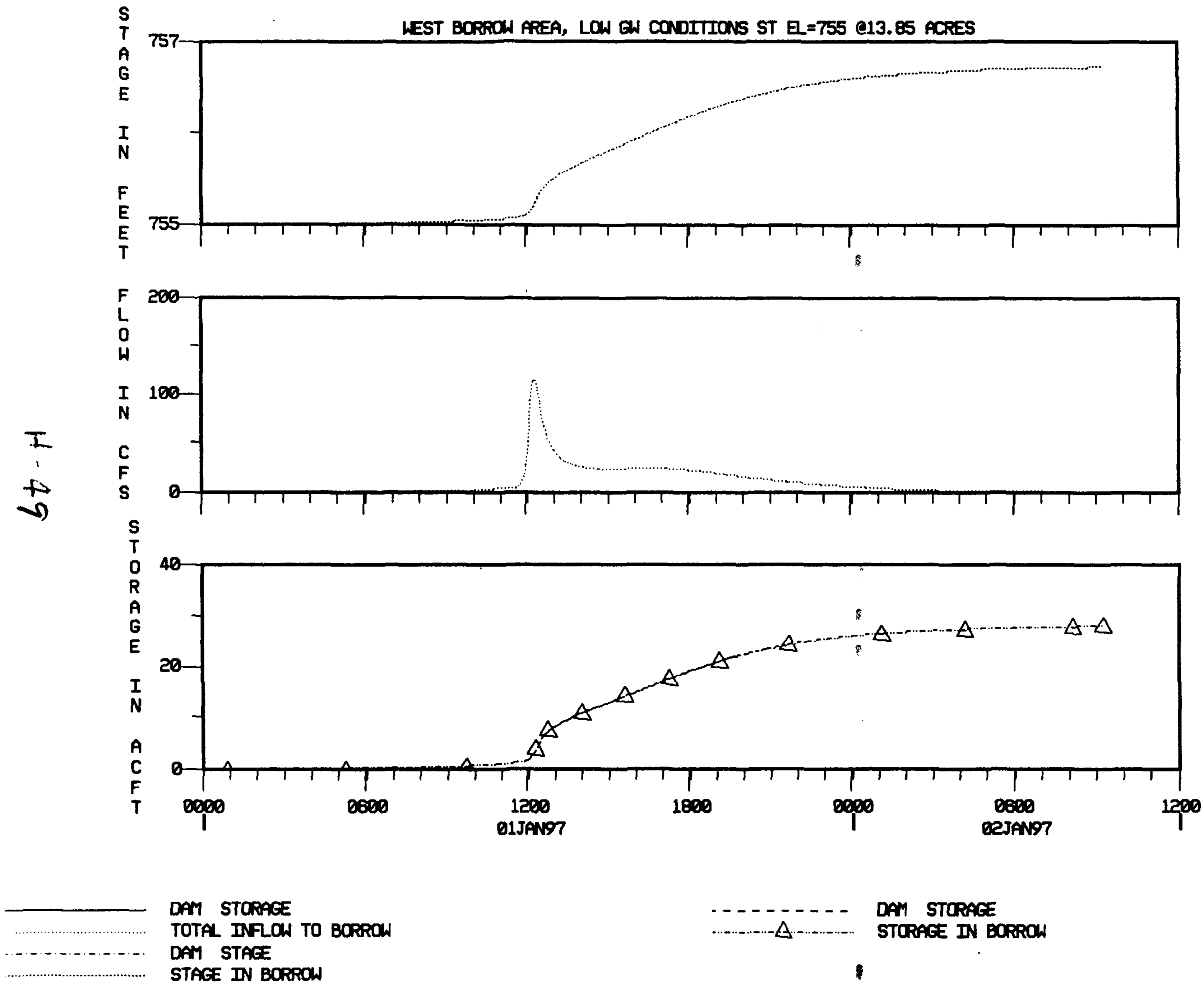
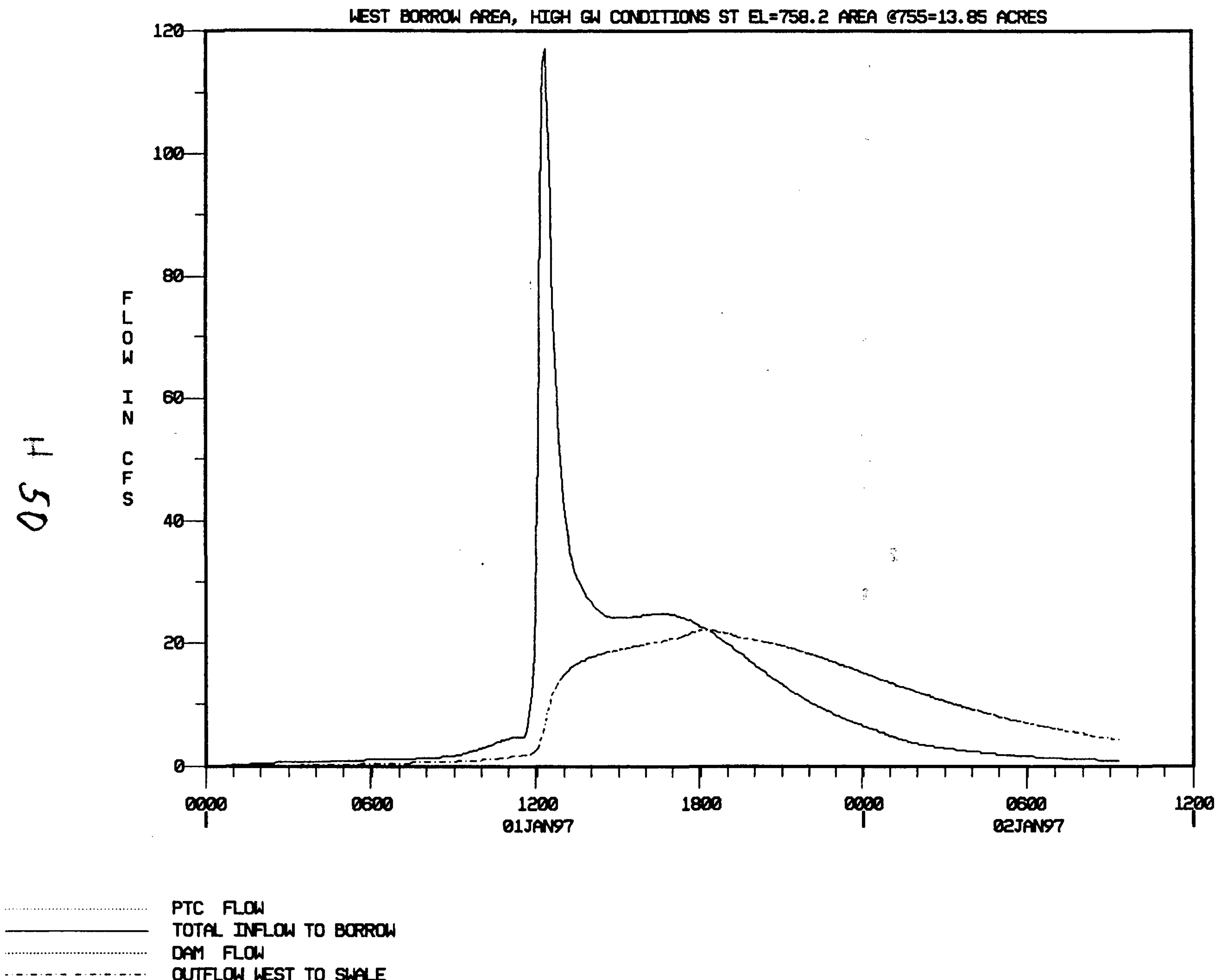


14.48

03APR96 :05

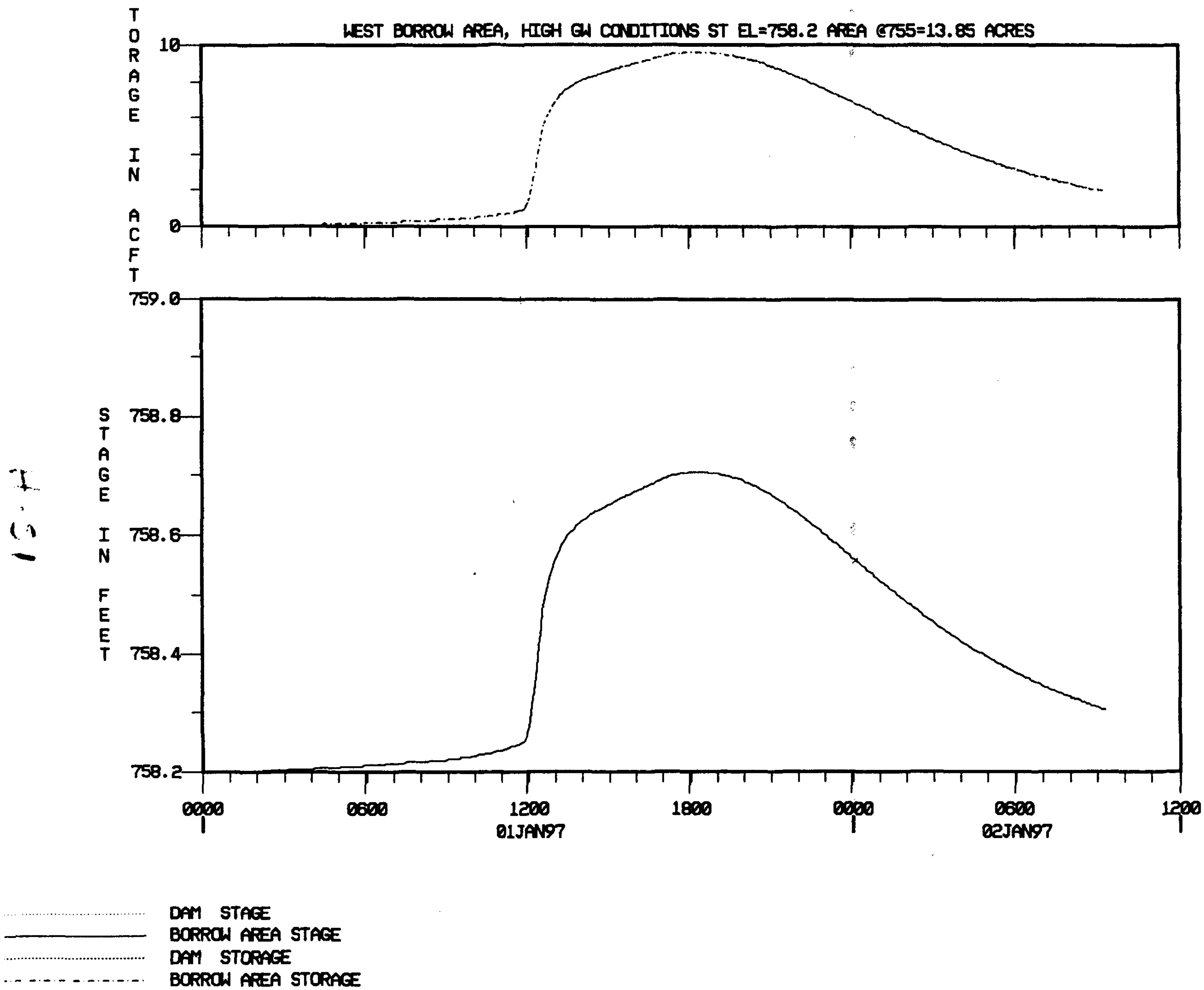

WEST BORROW AREA, LOW GW CONDITIONS ST EL=755 @13.85 ACRES
STAGE IN FEET
757
755
FLOW IN CFS
200
100
0
STORAGE IN AC FT
40
20
0
0000
0600
1200
1800
0000
0600
1200
01JAN97
02JAN97
DAM STORAGE
TOTAL INFLOW TO BORROW
DAM STAGE
STAGE IN BORROW
DAM STORAGE
STORAGE IN BORROW

03APR96 '6:46



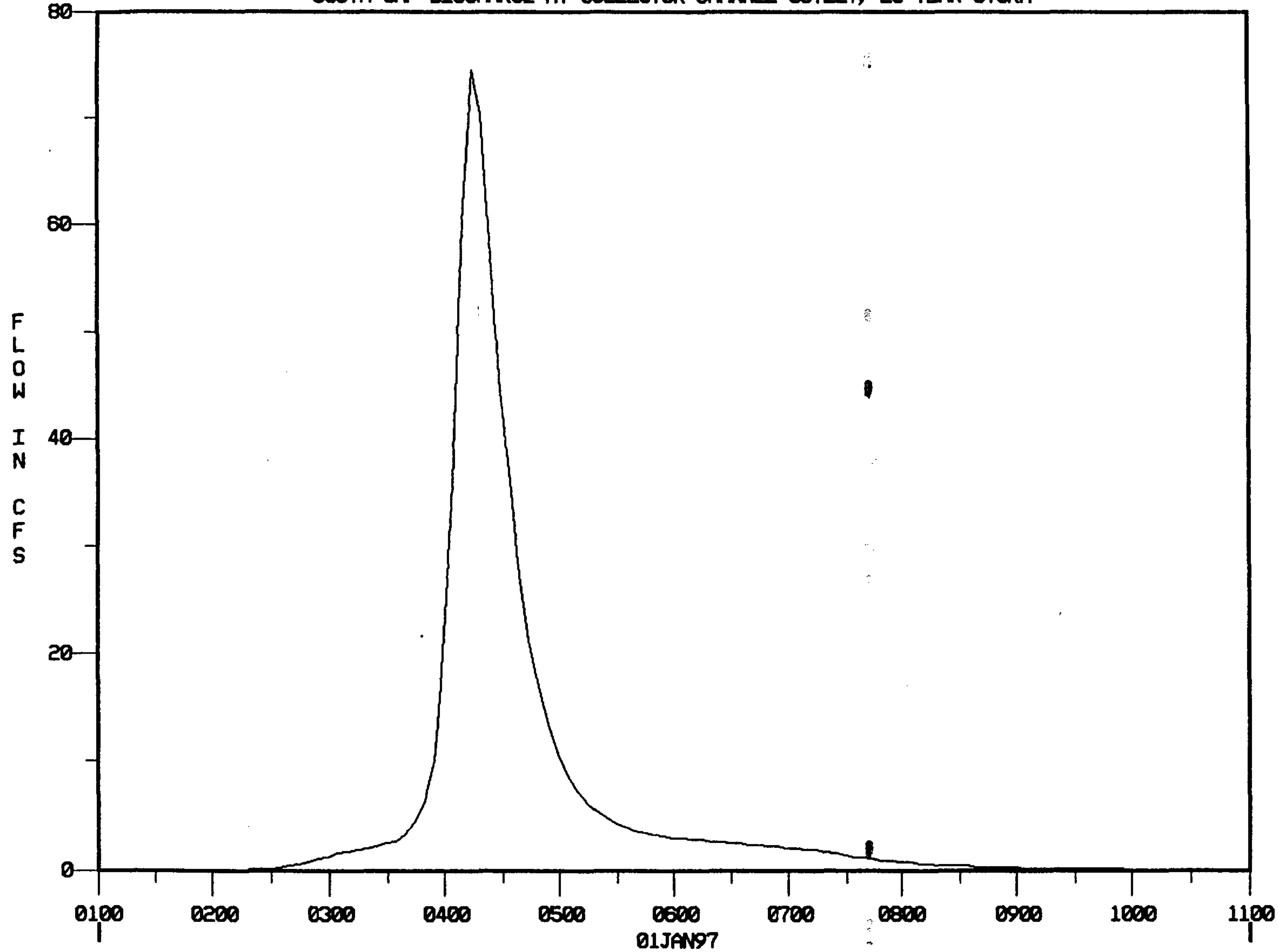
H 50

03APR96 3:46


WEST BORROW AREA, HIGH GW CONDITIONS ST EL=758.2 AREA @755=13.85 ACRES
STORAGE IN ACFT
10
0
STAGE IN FEET
759.0
758.8
758.6
758.4
758.2
0000
0600
1200
1800
0000
0600
1200
01JAN97
02JAN97
DAM STAGE
BORROW AREA STAGE
DAM STORAGE
BORROW AREA STORAGE

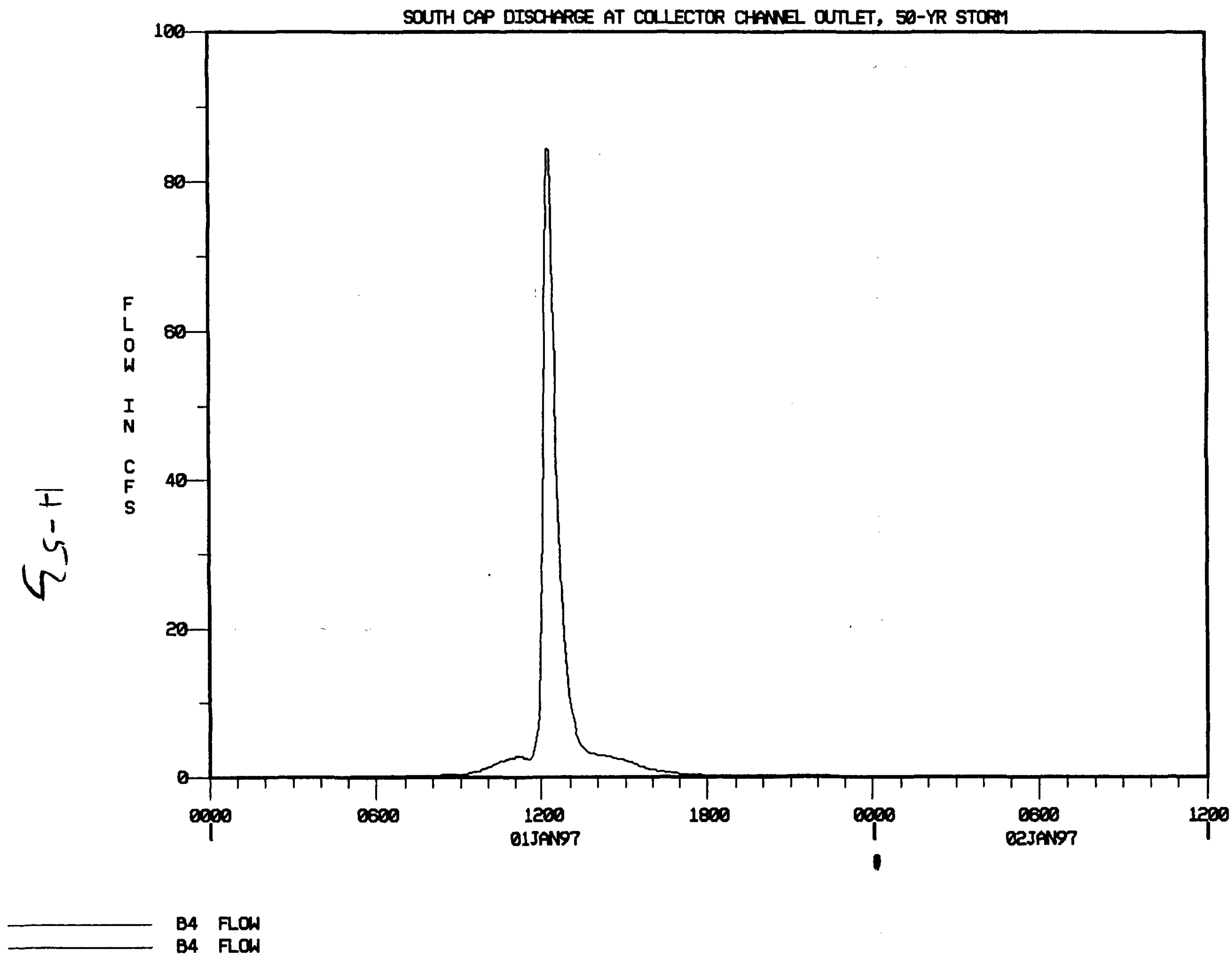
13MAR96 37:05

SOUTH CAP DISCHARGE AT COLLECTOR CHANNEL OUTLET, 25-YEAR STORM



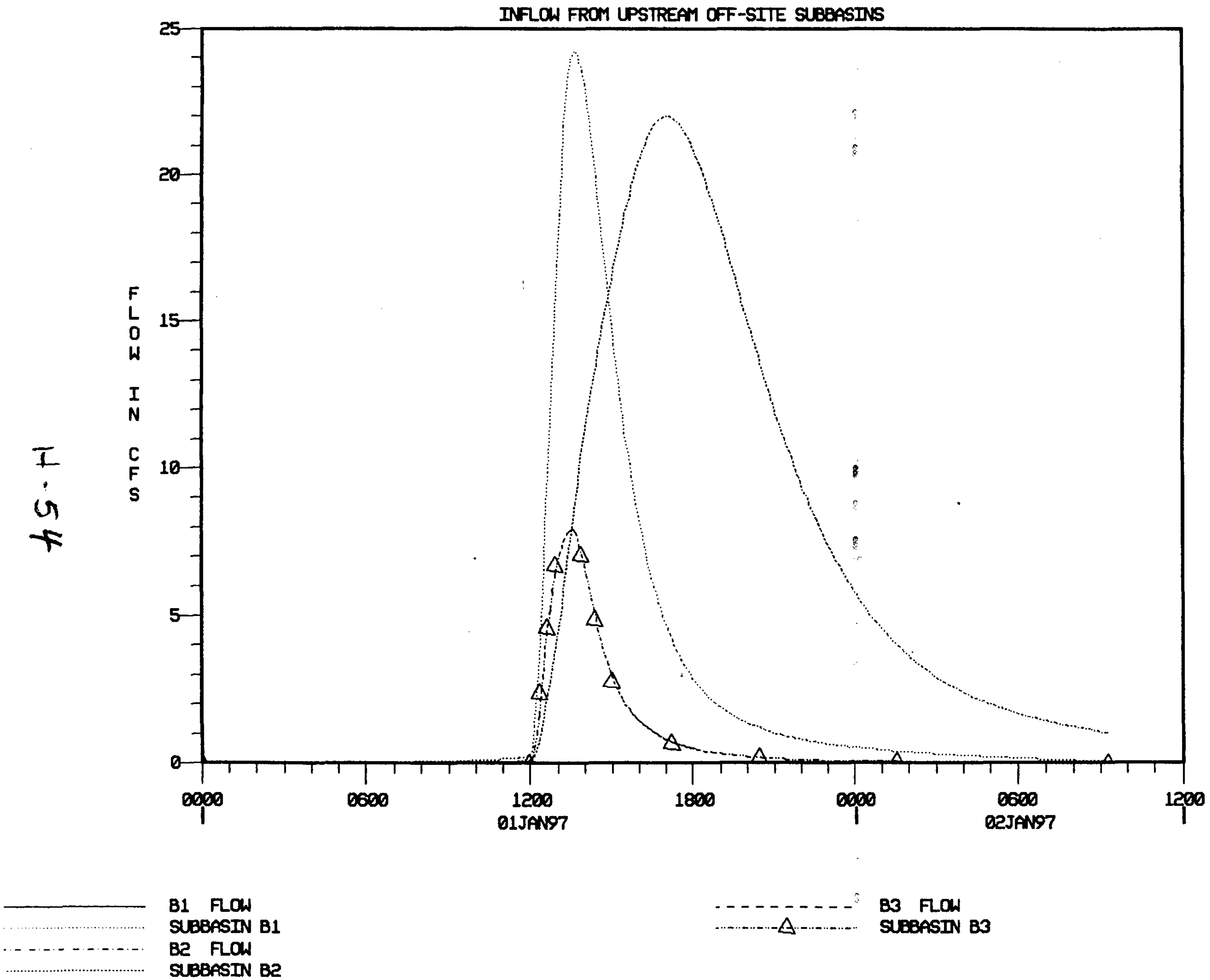
B4 FLOW

18MAR96 7:57



5S-H

18MAR96 08:05



H-54

CHP.I.M

OMAHA DISTRICT COMPUTATION SHEET CORPS OF ENGINEERS

PROJECT HIMCO DUMP - Elkhart, IND	SHEET NO. 1 OF
ITEM RATIONAL METHOD	BY M. Nelson — DATE 11 Mar 96
	CHKD. BY — DATE

$$Q = C\,i\,A$$

where
Q = Peak discharge in cfs
i = Intensity of rainfall in iph
A = Drainage area in acres
C = Runoff Coefficient

A Rainfall intensity i (iph)

1) Develop Rainfall Intensity - Duration - Frequency Curves (From Hydro35 & TP40

DUR \ FREQ	25-YR	25-YR iph	50-YR	50-YR iph	
5 min	0.64"	7.68	0.71"	8.52	(5 min)
15 min	1.32"	5.28	1.45"	5.80	(15 min)
60 min	2.41"	2.41	2.71"	2.71	(60 min)
2 HR	2.60"	1.30	2.85"	1.42	(120 min)
3 HR	2.80"	0.93	3.10"	1.03	(180 min)
6 HR	3.30"	0.55	3.70"	0.62	(360 min)
12 HR			4.2		
24 HR			5.0		

B INLET TIME OF CONCENTRATION

1) North Side of Cap - External Drainage Area

a) Length of drainage to most remote point = (2.55 ; 2.55") = 2.55"

L = 2000'*2.55" = 5,100 FT

b) Height above outlet = 778 - 760 = 18'

c) From Nomograph Base Tc = 49 min

From Plots:

i_{25} = 2.80 iph

i_{50} = 3.18 iph

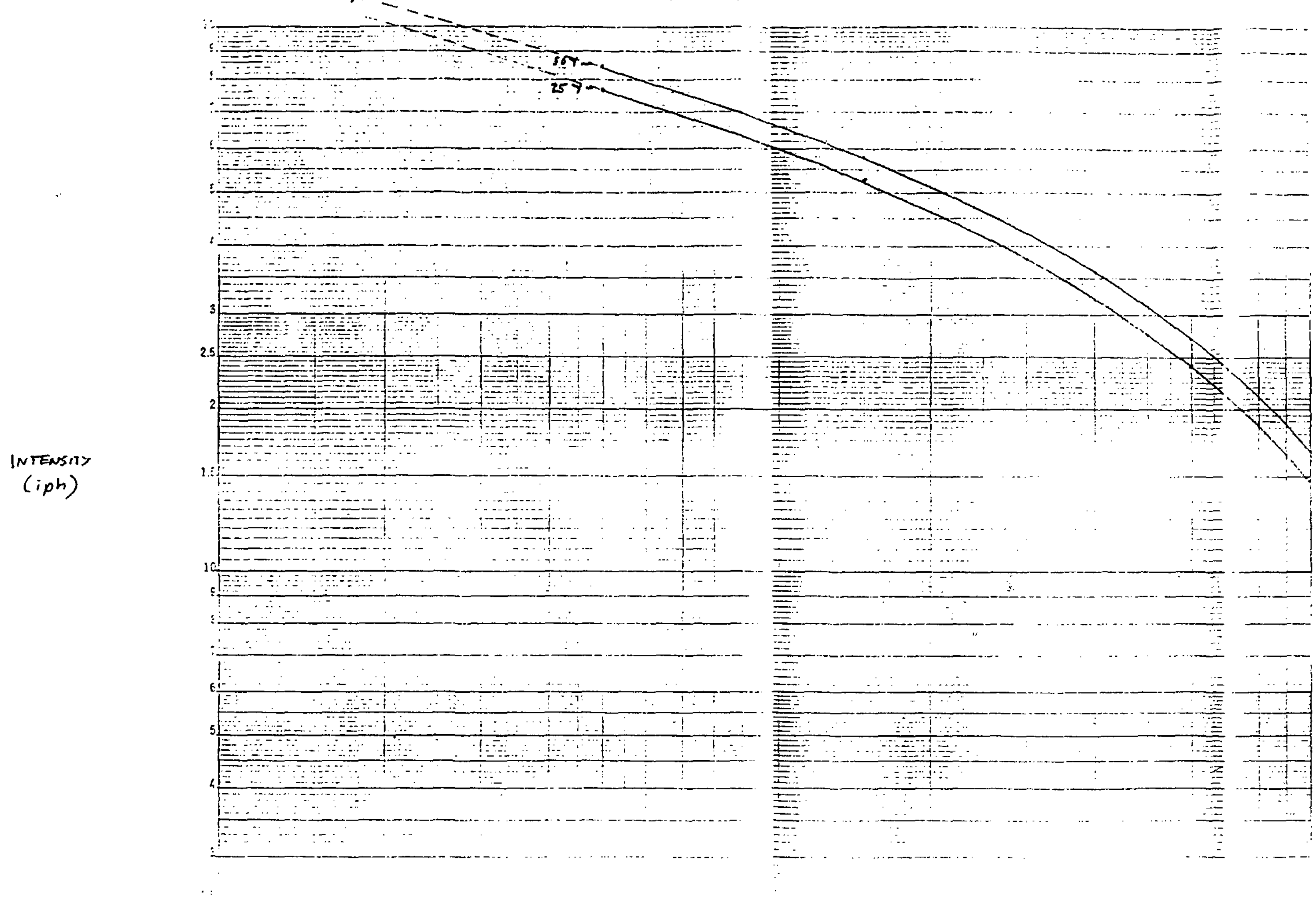
2) North Side of Cap - Landfill cap

MRO Form 1550, 1 DEC 83

☆U.S.G.P.O.: 1995-657-136

Rainfall Intensity - Duration - Frequency NORTHERN INDIANA

INTENSITY CURVES FOR RATIONAL METHOD



TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

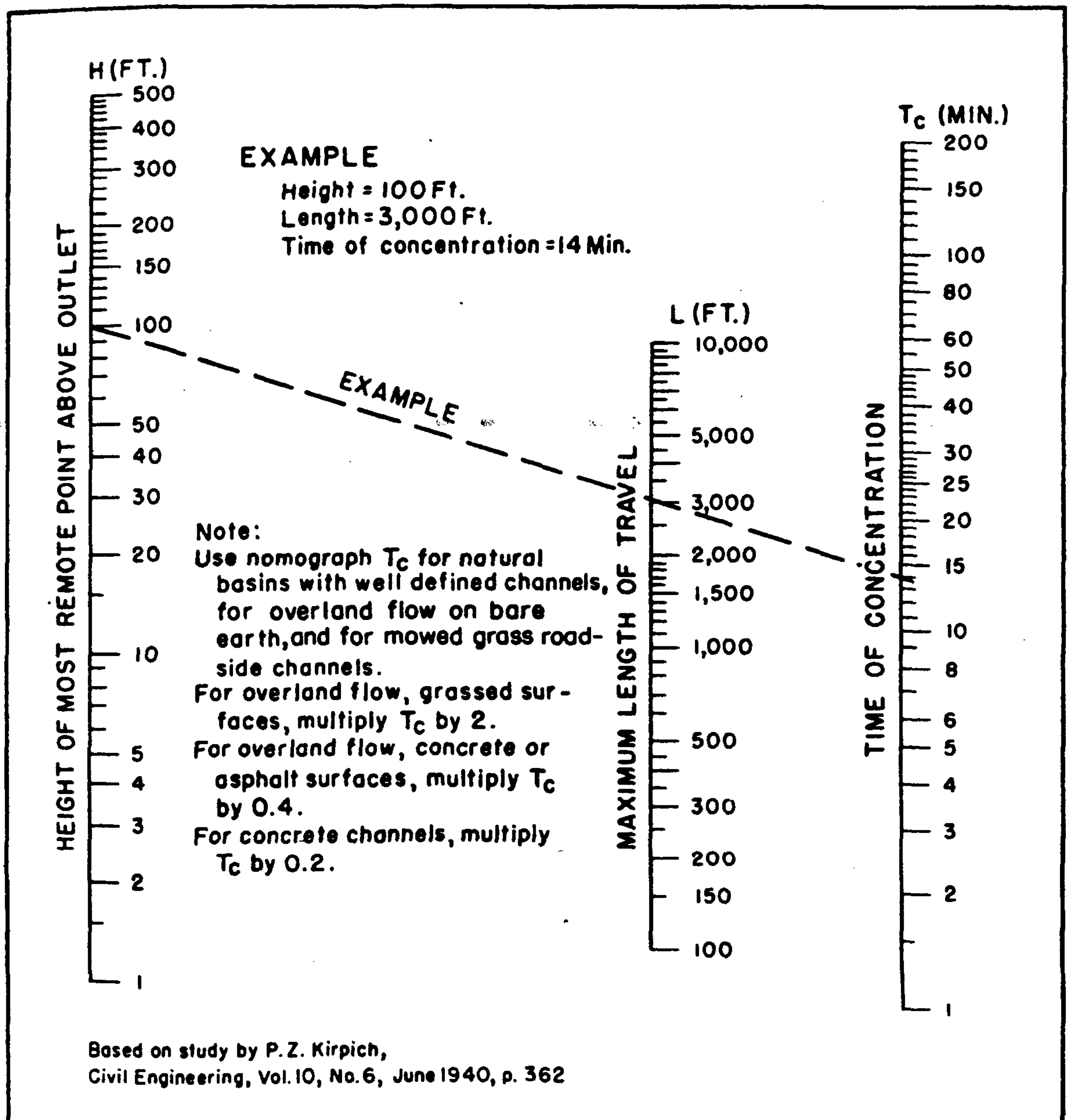


FIGURE 1

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO DUMP - Elkhart, IND	SHEET NO. 1	OF
ITEM CHANNEL DESIGN VALUES	BY M. Nelson	DATE 13 MAR 96
RATIONAL METHOD Check ON SUBBASINS	CHKD. BY	DATE

1 SUBBASIN A-1 (Culvert)

C: Sideslopes, Turf $S = 2\%$ to 10%

$C = 0.50$

i: T_c: $L = 400'$ $\Rightarrow T_c = 2.25$ for grassed surface $T_c' = T_c \times 2$

$\Delta h = 23'$

$T_c = 2.25 \times 2 = 4.5$ min

$i_{25} = 7.9$ iph

$i_{50} = 8.7$ iph

A: Area in acres $= .0059 \times 640 = 3.78$ acres

$Q_{25} = 0.5 * (7.9) * 3.78 = 15$ cfs HEC-1 $\Rightarrow$ 16.5 cfs

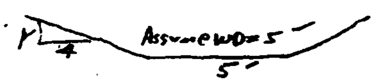
$Q_{50} = 0.5 * (8.7) * 3.78 = 16$ cfs

2 SUBBASINS A-1 & A-2 Combined "North Cap Discharges in Channel"

$C = 0.50$ $S: 2 < 9.7 < 40$ $Q = AV$

i: $T_c' = 4.5$ min + Inlet T_c $Q/V = A$

Inlet T_c: Assume $d = 1'$



$S = .0019$

$n = .045$

$A = 5 + 4 = 9\ FT^2$

$R = A/P = 9/2 \times \sqrt{17} + 5 = 0.68'$

$V = \frac{1.49}{.045} (.68)^{2/3} (.0019)^{1/2} = 1.13$ FT/sec

Assume $Q = 40$ cfs, solve back for $A = Q/V = 40/1.13 = 35.4\ FT^2$

Assume $d = 2'$

$A = 5 \times 2 + (8 \times 2) = 26\ FT^2$

$R = 26/(5 + (\sqrt{68} \times 2)) = 26/21 = 1.24'$

$V = \frac{1.49}{.045} (1.24)^{2/3} (.0019)^{1/2} = 1.67$ FT/sec

$A = 40/1.67 = 24\ FT^2 \sim 26\ FT^2$

$\therefore$ Inlet $T_c = 1060' / 1.65$ FT/sec $= 642$ sec $= 10.7$ min

$T_c = 4.5$ min $+ 10.7$ min $= 15.2$ min

$i_{25} = 5.2$ iph $i_{50} = 5.8$ iph

$A = 3.78 + (.0103 \times 640) = 10.37$

$Q_{25} = 0.5 * (5.2) * (10.37) = 27$ cfs

$Q_{50} = 0.5 * (5.8) * (10.37) = 30$ cfs

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO DUMP – Elkhart, IND		SHEET NO. 2	OF
ITEM Channel Design Values		BY M. Nelson	DATE 14 Mar 96
RATIONAL METHOD CHECK ON SUBBASINS		CHKD. BY	DATE

3 Subbasin B-4 "South Cap Discharges at Collecting Channel Outlet"

$C = 0.50$ S: 2<5.8<10

i: T_c: $L = 409'$ $T_{c\,ovl} = 2.25$ for grassed surface

$\Delta h = 24'$ $T_{c\,ovl}' = 2.25 * 2 = 4.5$ min

T_c INLET   Assume $d = 2'$ LWO $= 5'$ with 1:4 slopes

$A = 26\,FT^2$, $P = 21'$ $R = 1.24'$ $S = .0026$

$V = \frac{1.49}{.045} (1.24)^{2/3} (.0026)^{1/2} = 1.95$ FT/sec $n = .045$

Assume Q = 75 cfs $A = 75/1.95 = 38\,FT^2$

Assume $d = 2.25'$

$A = (5 \times 2.25) + (9 \times 2.25) = 31.5\,FT^2$ $P = 5 + \sqrt{2}\,(\sqrt{(2.25)^2 + 9^2})$

$V = \frac{1.49}{.045} (1.34)^{2/3} (.0026)^{1/2} = 2.08$ FT/sec $P = 23.6$ $R = \frac{31.5}{23.6}$

$R = 1.34$

$A = 75/2.08 = 36\,FT^2$

Conclude $\hat{V} = 2.15$ FT/sec

$T_{c\,inlet} = 1560\,FT / 2.15$ FT/sec $= 726$ min $= 12.1$ min

$T_c = 12.1 + 4.5 = 16.6$ min

$i_{25} = 5.0$ iph

$i_{50} = 5.6$ iph

$A = 0.0287\,mi^2 * 640\,Ac/mi^2 = 18.37$ Acres

$Q_{25} = 0.5 * 5.0 * 18.37 = 46$ cfs

$Q_{50} = 0.5 * 5.6 * 18.37 = 51$ cfs

4 CAP ROAD DITCH PORTION OF REGION A-4 (CAP)

C: Slope: Rise $= 18'$ $S = 0.04$ 2<5<10

Run $= 450'$

$C = 0.50$

I: T_c: $L = 450$ $T_c = 2.8$ min

$\Delta h = 18'$

$i_{25} = 9.2$ iph $i_{50} = 10.0$ iph

$A = 0.001722\,mi^2 = 1.10$ Acres

$Q_{25} = 0.5 * 9.2 * 1.10 = 5.1$ cfs

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HINCO DUMP - Elkhart, IND		SHEET NO.	OF
ITEM Culvert Design (Under Cap Road)		BY M. Nelson	DATE 19 MAR 96
		CHKD. BY	DATE

A DESIGN DISCHARGES (A1)

$Q_{25} = 17$ cfs

$Q_{50} = 20$ cfs ⇐ DSN Q

B Assumptions:

1) RCP
2) End Section Corresponds to fill slope
3) Allowable Headwater IS 4' (from Plan View)
4) Channel Slope = 0.003 (from Plan View)
5) Pipe Length = 60' (From Plan view)

C INLET CONTROL (FROM BPR Nomograph)

1) TRY 18" RCP — Too Small
2) TRY 24" RCP ⇒ HW/D = 1.5 AHW = 4.0'
HW Req = 3.0' < 4.0' OK

D CHECK OUTLET CONTROL (From BPR Nomograph)

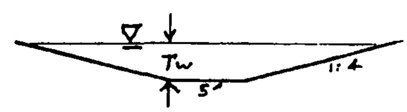
$HW = H + h_o - L*S_o$

H: From Nomograph ($K_e = 0.5$, L = 60', D = 2', Q = 20 cfs)
H = 2.1'

h_o: $\frac{d_c + D}{2}$ vs Tail WATER   D = 2'
d_c = Critical Depth in Pipe at 20 cfs = 1.6'
(From Concrete Pipe Book)

$\frac{1.6 + 2}{2} = 1.8'$

Tw: Assume Tw = 1.5'



$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

n = 0.012 (Concrete Pipe)

$Q = \frac{1.49}{0.012} (9)(.52)^{2/3}(.003)^{1/2}$ S = .003

A = 6×1.5 = 9 ft² $P = 5 + 2\sqrt{1.5^2 + 6^2}$

Q = 124×9×0.65×.055   R = A/P = 9/17.4 = 0.52   P = 17.4'

Q = 39.7 < 20 ∴ Tw < 1.5 < 1.8
so h_o = 1.8'

$L*S_o$ = 60' × 0.003 = 0.18'

HW = 2.1' + 1.8' − 0.18 = 3.72'

3.72 > 3.0 ∴ Outlet Control Governs

3.72 = HW < 4.0 = AHW so 24" RCP ok

USE 24" RCP

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO DUMP - Elkhart, IND		SHEET NO. 1	OF
ITEM USGS REGIONAL EQUATIONS as A Check		BY M. Nelson	DATE 11 Mar 96
		CHKD. BY	DATE

A LOCATION = AREA 1

B EQUATION PARAMETERS DEFINED

$$Q_{25} = 11.8\, DA^{0.697} * (STOR+1)^{-0.253} * (PREC-30)^{1.093}$$

$$Q_{50} = 12.9\, DA^{0.696} * (STOR+1)^{-0.248} * (PREC-30)^{1.114}$$

where DA = Contributing Drainage Area in mi^2
STOR = % of contributing DA covered by lakes, ponds & wetlands.
PREC = Mean annual Precip in inches = 35"

OFF-SITE SUBBASINS

1) Try B-3 (Least urbanized)
STOR = 5% A = 0.0443 mi^2

$$Q_{25} = 11.8(.044)^{0.697} * (5+1)^{-0.253} * (35-30)^{1.093}$$
$= 1.34 * 0.64 * 5.81 =$ 5 cfs compares with 7.5 cfs HEC-1
OK

2) Try B-2
STOR = 5%, A = 0.291 mi^2

$Q_{25} = 11.8(.291)^{0.697} * 0.64 * 5.81 =$ 19 cfs compares with 23 cfs from HEC-1
TRY URBAN ADJUSTMENT

$$UQ_{25} = 2.78\, A^{.31} * SL^{0.15} * (RI2+3)^{1.76} * (ST+8)^{-0.55} * (13-BDF)^{-.29} * IA^{.07} * RQ_{25}^{.60}$$ where:

A = Contrib Area in mi^2 = 0.291 mi^2
SL = Main Channel slope in FT/mi between 10 & 85% of dist upstream from site = 9'/.61 mi = 14.85 FT/mi
RI2 = 2 hr, 2 YR Rain from TP-40 = 1.63"
ST = Basin Storage = 5%
IA = 3%
BDF: Upper 1/3 0, 0, 0, 0 = 1
Mid 1/3 0, 0, 0, 1
Lower 1/3 0, 0, 0, 0

$$UQ_{25} = 2.78(.291)^{.31} * (14.85)^{.15} * (1.63+3)^{1.76} * (5+8)^{-0.55} * (13-1)^{-.29} * (3)^{.07} * (19)^{.60}$$
$= 0.25 * 1.5 * 14.8 * 0.24 * 0.49 * 1.08 * 5.85 = 4.1$ (too low)

USE 19 cfs

MRO Form 1550, 1 DEC 83

U.S.G.P.O.: 1995-657-136

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO HTW		SHEET NO. 1	OF
ITEM Computations Using Final Sizes For Pits & Borrow Areas		BY M. Nelson	DATE 11 Apr 96
		CHKD. BY	DATE

I GIVEN:

A Quarry Pond East

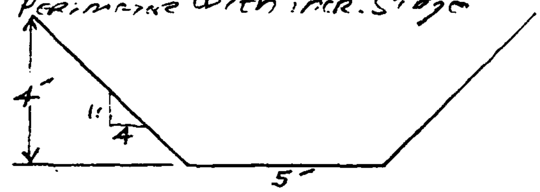
ELEV	AREA (Acres)	PERIM. (Feet)
756	23.8	4940
758	25.2	5060

B West Borrow Pit

ELEV	AREA (Acres)	PERIM. (Feet)
756	14.8	6,650*
758	18.53	4,210

*L shaped pond submerges reducing Perimeter with incr. Stage

C Final South Ditch Dimensions For Culvert under Cap Road:



II RESULTS - HIGH WATER TABLE CONDITION ASSUMED

A Maximum Water Surface in Pit

1) EAST QUARRY POND (25-YR EVENT) START EL = 756.1

Peak INFLOW = 203 cfs

Peak Volume STORED = 21.4 AF

Max Elevation Reached = 757.0

Inlet Invert 30" RCP = 757.09

Outlet Invert 30" RCP = 755.95

2) WEST BORROW PIT (25-YR EVENT) START EL = 758.2 with flow

Peak INFLOW = 87 cfs

Peak Volume STORED = 9.6 AF

Peak Outflow = 22 cfs

Max Elevation Reached = 758.7

Channel to West Invert = 758.2

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIN.LO HTW		SHEET NO. 2	OF
ITEM Computations Using Final Sizes		BY M. NELSON	DATE 11 April 96
		CHKD. BY	DATE

II RESULTS

B ANNUAL WATER BALANCE

1) From Earlier Computations
 a) Mean Annual Runoff to Pits = 220.2 ACRE FT
 b) Hydraulic Conductivity
 HORIZONTAL = 0.0022 cm/sec
 VERTICAL = 0
 c) Assume that after a heavy Rain, ponds are 0.5' higher than surrounding Water Table

2) New Pond Perimeters

Use 738 (High Water Table Condition)

Quarry	+	Borrow	=	Total P
5,060'	+	4,210'	=	9,270'

3) Calculations:

Ground Water Movement Area: $A = 0.5\,FT \times P$

$A = 0.5\,FT \times 9270\,FT = 4635\,FT^2$

Average Ground Water Capacity for Outflow:

$$V = \frac{0.0022\,cm}{sec} \cdot \frac{in}{2.54\,cm} \cdot \frac{FT}{12\,in} \cdot \frac{86{,}400\,sec}{DAY} \cdot \frac{365\,DAY}{YR} \cdot 4{,}635\,FT^2$$

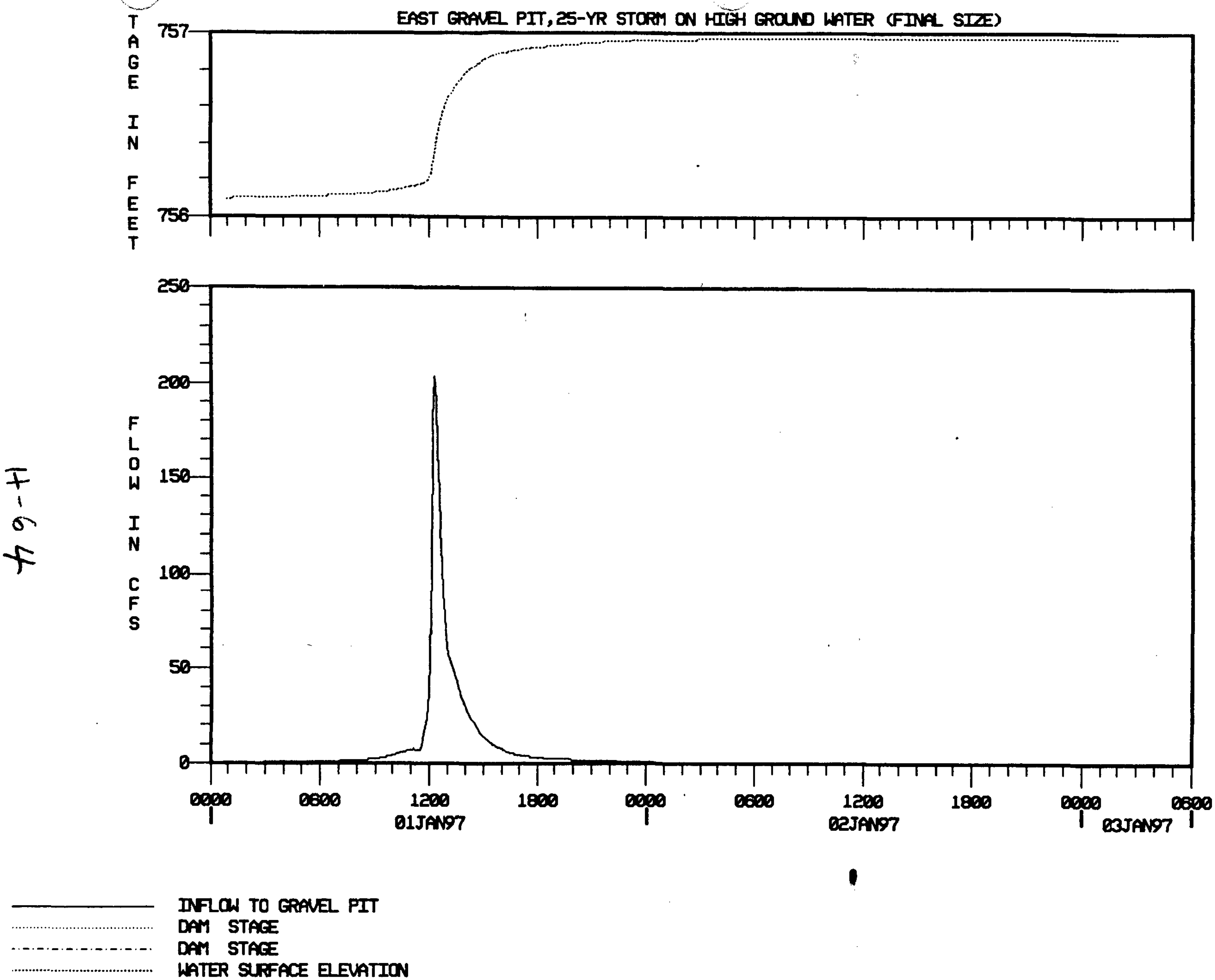
$V = 10{,}550{,}280\,FT^3$ $\quad$ 1 ACRE = 43,560 FT^2

V = 242 Acre Ft OUT

Average Volume to get Rid of = 220 AF

∴ Should be able to get Rid of an average years water yield.

11APR96 42:38



H-64

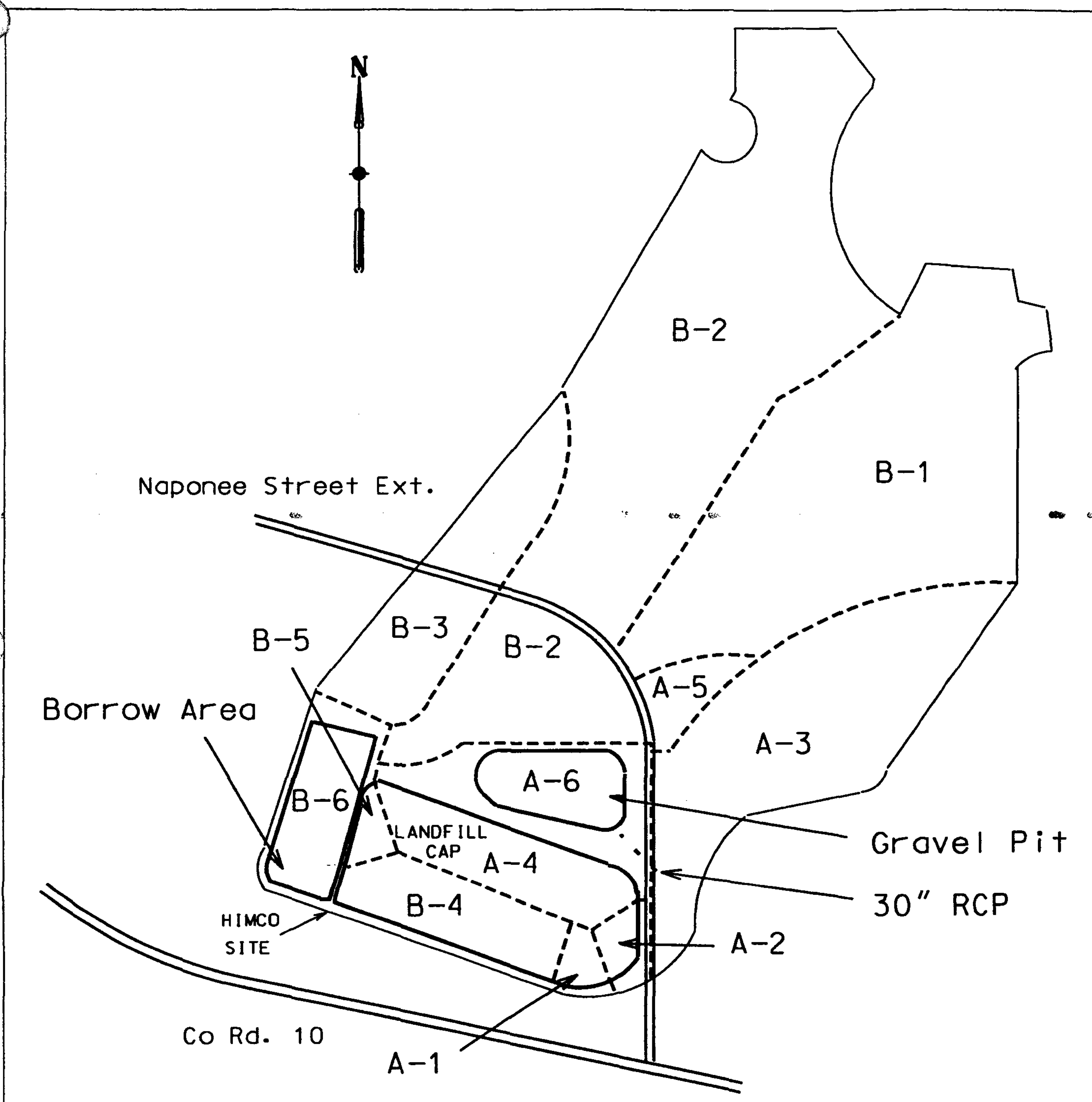


FIGURE 1
BASIN DEPICTION MAP

d:/dgn/himco.dgn May. 10, 1996 13:10:06

APPENDIX I

REMEDIAL ACTION

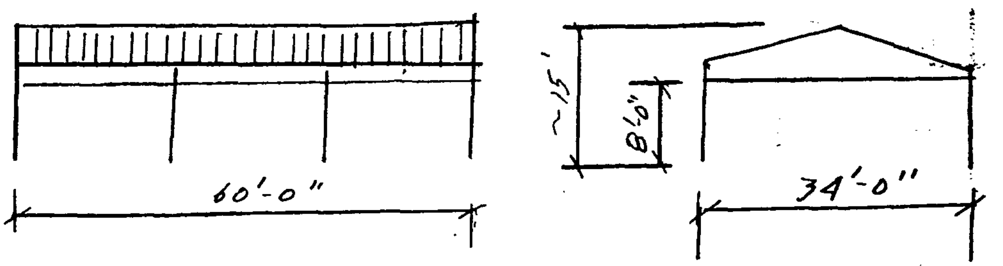
HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX I
STRUCTURAL DESIGN CALCULATIONS

PROJECT HIMCO	SHEET NO. 1	OF
ITEM	BY LEP	DATE Dec 95
	CHKD. BY	DATE

Roof over gas treatment equipment:



SIDE ELEVATION　　　END ELEVATION

Snow Loads per ASCE 7-93

$P_s = 0.7\, C_s C_e C_t I P_g$

Unheated, Slope < 50° ⇒ $C_s = 1.0$

Exposure C ⇒ $C_e = 1.0$

Unheated ⇒ $C_t = 1.2$

Category I ⇒ $I = 1.0$

Elkhart, IN ⇒ $P_g = 20$ psf

$P_s = 0.7(1.0)(1.0)(1.2)(1.0)(20) = 17$ psf

> Use 20 psf minimum construction load

Wind Loads per ASCE 7-93

Pressures per paragraph 6.7.2 "Roof Overhangs"

Main wind-force resisting system $P = q\, G_h C_p$

Where $q = 0.00256\, K_z (IV)^2$

Exposure C, Ht = 15' ⇒ $K_z = 0.80$

Category I ⇒ $I = 1.0$

Elkhart, IN ⇒ $V = 80$ mph

$q = 0.00256(0.80)[(1.0)(80)]^2 = 13.1$ psf

Exposure C, H = 15' ⇒ $G_h = 1.32$

$\theta = 14°$, $H/L < 2.5$ ⇒ $C_p = 0.2, -0.9$ roof

In addition, apply positive pressure of $C_p = 0.8$ to underside of roof overhangs.

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO	SHEET NO. 2	OF
ITEM	BY LEP	DATE Dec 95
	CHKD. BY	DATE

$C_p = 0.8$ windward wall
$C_p = -0.5$ leeward wall

∴ Pressure for rigid frame design:

Windward roof $P = 13.1(1.32)(0.2) = 3.5$ psf
Leeward roof $P = 13.1(1.32)(-0.9-0.8) = -29.4$ psf
Windward wall $P = 13.1(1.32)(0.8) = 13.8$ psf
Leeward wall $P = 13.1(1.32)(-0.5) = -8.6$ psf

Components and Cladding $P = q(GC_p) - q(GC_{pi})$

$GC_p = -1.3$ Main roof area
$GC_p = -3.0$ Edge strip 3' wide

$GC_{pi} = 0.75, -0.25$

∴ Uplift on roof components
$P = 13.1(-1.3) - 13.1(0.75) = 27$ psf main area
$P = 13.1(-3.0) - 13.1(0.75) = 49$ psf edge strip

Seismic Loads per ASCE 7-93

$$\text{Base shear} = \frac{1.2(A_v)(S)\,W}{RT^{2/3}} = \frac{1.2(0.08)(2.0)\,W}{4.5(0.23)^{2/3}} = 0.11\,W$$

Metal Roof Deck

Ref= Vulcraft
Span = 5'
LL = 49 psf wind uplift
Try 1.5 B22, Allowable DL+LL = 91 psf OK
Construction Max. Span = 5'-7" OK

$$\boxed{\begin{array}{l}\text{Use } 1\tfrac{1}{2}\text{" wide rib steel deck} \\ t = 0.0295\ ,\ I = 0.167 \\ S_p = 0.186\ ,\ S_n = 0.194\end{array}}$$

Determine fasteners based on wind shear.

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO	SHEET NO. 3	OF
ITEM	BY LEP	DATE Dec 95
	CHKD. BY	DATE

Long Span Joists span = 34', spacing = 5'

Ref: Vulcraft

Roof DL := 2 psf deck
3 psf metal roof
5 psf

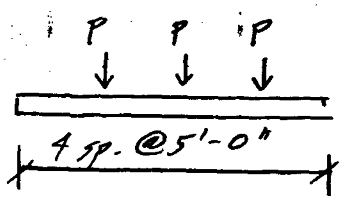
$DL+LL = (20+5)5 = 125$ plf ↓

Uplift $= (29.4)5 = 150$ plf ↑

∴ 20LH6 OK $w_t = 15$ plf, $I = 26.77(267)(34)^3(10^{-6}) = 280$ in^4

Joist Girders

Ref: Vulcraft

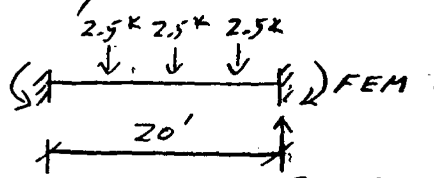


$DL+LL: P = (125+15)(34/2) = 2,400^{lb}$ ↓

Uplift $P = (-150+15)(34/2) = 2,300^{lb}$ ↑

Conservatively say 2.5^K either ↓ or ↑

Fixed end moment



$R_{xy} = 3.75^K$

$$FEM = \frac{2.5(5)(15)^2}{(20)^2} + \frac{2.5(10)(10)^2}{(20)^2} + \frac{2.5(15)(5)^2}{(20)^2} = 15.6^{K\text{-}ft}$$

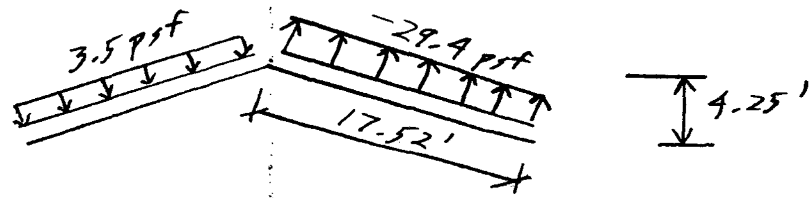
Use 20GN2.5K Joist Girder
Design Connection for $16^{K\text{-}ft}$

wt =

$I = 110$ in^4

Lateral Loads (Wind)

Normal to ridge

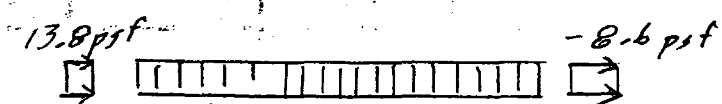


Lateral Load = Horizontal Component = 4.25(3.5 + 29.4) = 140 plf

Reaction @ rigid frame = 140 (20) = 2,800 lb

Shear in metal deck = $\frac{140(20/2)}{17.52}$ = 80 plf

Perpendicular to ridge



assume roof assemby forms a "wall" against wind pressure 4.25' x 34'

Lateral Load = 4.25(13.8 + 8.6) = 95 plf

Reaction @ rigid frame = 95 (34/2) = 1,620 lb

Shear in metal deck = $\frac{1620}{60}$ = 27 plf

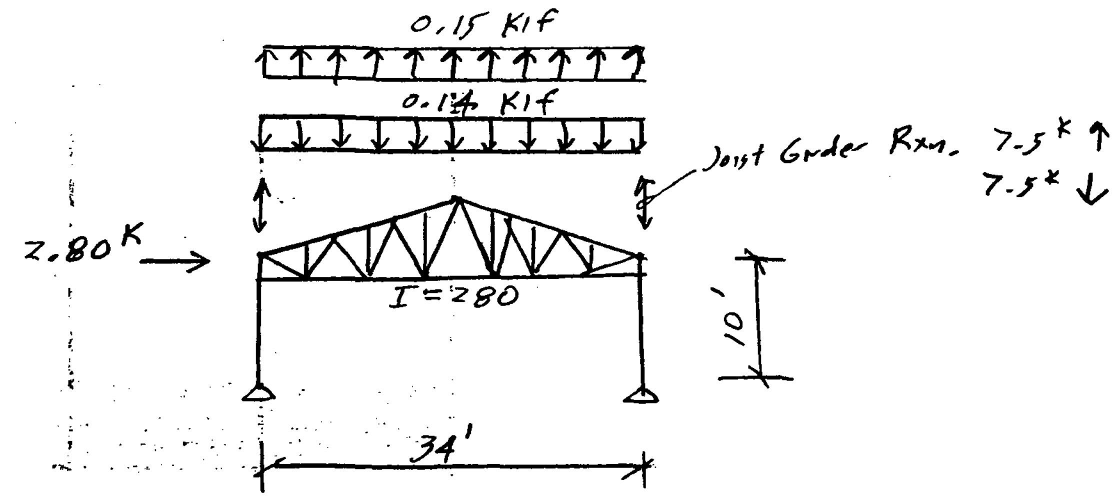
Try 36/3 fastener spacing for metal deck, no sidelaps

fastener	Vallow	
weld	153	
Hilti	164	> 80 OK
Ramset	162	

$\boxed{\text{Use fasteners @ 18", no sidelaps}}$

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO		SHEET NO. 5	OF
ITEM		BY LEP	DATE Dec 95
		CHKD. BY	DATE

Transverse Rigid Frame



Conservatively used smallest possible I of joist = 280 to put max. M on column.

Column. Axial Compr. = 10.9^k
Max. M = 25.1^{kft}
$\Delta = 0.30'' = H/400$ OK

$\therefore$ Additional M due to $P\Delta = 10.9\left(\frac{0.30}{12}\right) = 0.3^{k\cdot ft}$

$M_{total} = 25.1 + 0.3 = 25.4^{k\cdot ft}$

~~Try W12 x 26~~

$A = 7.65 in^2 \Rightarrow f_a = 1.42$
$S_x = 38.6 in^3 \Rightarrow f_b = 7.90$
$r_y = 1.52 in$

$K\ell/r = 2.1(10)(12)/1.52 = 165.8 \Rightarrow F_a = 5.43$
$F'_e = 5.43$

$\ell d/A_f = 10(12)(4.95) = 594 \Rightarrow F_b = 20.2$

$\frac{1.42}{5.43} + \frac{1.0(7.90)}{(1-1.42/5.43)20.2} = 0.79 < 1.33$ OK

$\frac{1.42}{0.6(36)} + \frac{7.90}{20.2} = 0.46 < 1.33$ OK

Fixed End Moment of Girder $= \frac{0.15(34)^2}{12} = 14.4^{k\cdot ft} < 25.1$ OK

MRO Form 1550, 1 DEC 83

5A

```
 1. STAAD PLANE
 2. *
 3. *  TRANSVERSE RIGID FRAME
 4. *
 5. UNITS FEET KIPS
 6. JOINT COORDINATES
 7. 1 0 0 0
 8. 2 0 10 0
 9. 3 34 10 0
10. 4 34 0 0
11. MEMBER INCIDENCES
12. 1 1 2 3
13. MEMBER PROPERTIES
14. 1 3 TA ST W12X35
15. 2 TA ST W16X26
16. CONSTANTS
17. E STEEL ALL
18. SUPPORTS
19. 1 4 PINNED
20. *
21. LOADING 1 DL+LL+SWAY
22. MEMBER LOAD
23. 2 UNI GY -0.15
24. JOINT LOAD
25. 2 3 FY -7.5
26. 2 FX 2.8
27. *
28. LOADING 2 UPLIFT+SWAY
29. MEMBER LOAD
30. 2 UNI Y 0.14
31. JOINT LOAD
32. 2 3 FY 7.5
33. 2 FX 2.8
34. *
35. PERFORM ANALYSIS

        P R O B L E M   S T A T I S T I C S
        -----------------------------------

   NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =      4/     3/     2
   ORIGINAL/FINAL BAND-WIDTH =      1/     1
   TOTAL PRIMARY LOAD CASES  =      2, TOTAL DEGREES OF FREEDOM =      8
   SIZE OF STIFFNESS MATRIX =       48 DOUBLE PREC. WORDS
   REQRD/AVAIL. DISK SPACE =  12.01/    29.6 MB,  EXMEM = 15.00 MB

++ PROCESSING ELEMENT STIFFNESS MATRIX.                        9:12:40
++ PROCESSING GLOBAL STIFFNESS MATRIX.                         9:12:40
++ PROCESSING TRIANGULAR FACTORIZATION.                        9:12:40
++ CALCULATING JOINT DISPLACEMENTS.                            9:12:40
++ CALCULATING MEMBER  FORCES.                                 9:12:42
```

36. PRINT SUPPORT REACTIONS

SUPPORT REACTIONS -UNIT KIPS FEET   STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	-0.22	9.23	0.00	0.00	0.00	0.00
	2	-2.51	-10.70	0.00	0.00	0.00	0.00
4	1	-2.58	10.87	0.00	0.00	0.00	0.00
	2	-0.29	-9.06	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

37. PRINT MEMBER FORCES

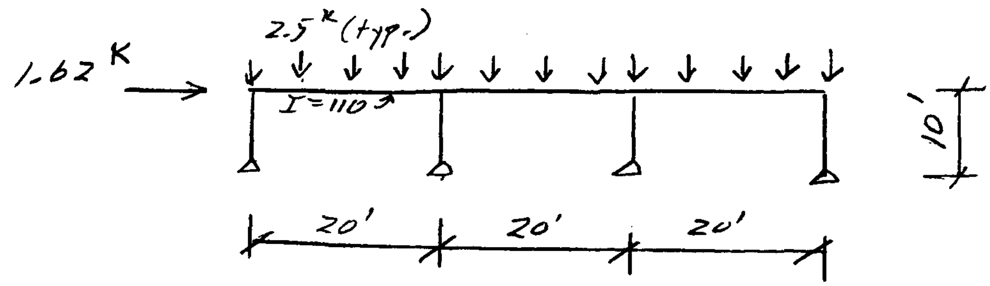
MEMBER END FORCES   STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIPS FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	9.23	0.22	0.00	0.00	0.00	0.00
		2	-9.23	-0.22	0.00	0.00	0.00	2.15
	2	1	-10.70	2.51	0.00	0.00	0.00	0.00
		2	10.70	-2.51	0.00	0.00	0.00	25.12
2	1	2	2.58	1.73	0.00	0.00	0.00	-2.15
		3	-2.58	3.37	0.00	0.00	0.00	-25.85
	2	2	0.29	-3.20	0.00	0.00	0.00	-25.12
		3	-0.29	-1.56	0.00	0.00	0.00	-2.88
3	1	3	10.87	2.58	0.00	0.00	0.00	25.85
		4	-10.87	-2.58	0.00	0.00	0.00	0.00
	2	3	-9.06	0.29	0.00	0.00	0.00	2.88
		4	9.06	-0.29	0.00	0.00	0.00	0.00

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO	SHEET NO. 6	OF
ITEM	BY LED	DATE Dec 95
	CHKD. BY	DATE

Longitudinal Rigid Frame



Try W12x26 Column

Column Max. Axial Compr = 11.3^K

Max. M = $8.02^{K\,ft}$

$\Delta = 0.52'' = H/230$ OK

∴ Additional M due to $P\Delta = 11.3\left(\frac{0.52}{12}\right) = 0.5^{K\text{-}ft}$

$f_a = \frac{11.3}{7.65} = 1.48$ Ksi

$f_b = \frac{(11.3 + 0.5)(12)}{5.34} = 26.5$ Ksi

$\frac{f_a}{F_a} + \frac{f_b}{F_b} = \frac{1.48}{5.43} + \frac{26.5}{27.0} = 1.25 < 1.33$ OK

Joist Girder Max. M due to gravity LL plus sway = $28^{K\text{-}ft}$

Connect Girder to column:

P →

P ←

20"

M = $28^{K\text{-}ft}$

$P = \frac{28}{(20/12)} = 16.8^K$

Use 1/4" fillet weld, $v_{allow} = 3.71^{K}/in$

Req L = $^{16.8}/_{3.71}$ = 4.5 in

```
STAAD PLANE
INPUT WIDTH 72
*
*  LONGITUDINAL RIGID FRAME
*
UNIT FEET KIP
JOINT COORDINATES
1 0. 0. 0.; 2 20. 0. 0.; 3 40. 0. 0.; 4 60. 0. 0.; 5 0. 10. 0.
6 20. 10. 0.; 7 40. 10. 0.; 8 60. 10. 0.
MEMBER INCIDENCES
1 1 5; 2 2 6; 3 3 7; 4 4 8; 5 5 6; 6 6 7; 7 7 8
MEMBER PROPERTY AMERICAN
1 TO 4 TABLE ST W12X35
5 TO 7 TABLE ST W12X19
CONSTANTS
E STEEL ALL
BETA 90 MEMBER 1 TO 4
SUPPORTS
1 TO 4 PINNED
*
LOAD 1 DL+LL+SWAY
MEMBER LOAD
5 TO 7 CON Y -2.5 0.001 0.
5 TO 7 CON Y -2.5 5. 0.
5 TO 7 CON Y -2.5 10. 0.
5 TO 7 CON Y -2.5 15. 0.
7 CON Y -2.5 19.999 0.
JOINT LOAD
5 FX 1.62
*
LOAD 2 UPLIFT+SWAY
MEMBER LOAD
5 TO 7 CON Y 2.5 0. 0.
5 TO 7 CON Y 2.5 5. 0.
5 TO 7 CON Y 2.5 10. 0.
5 TO 7 CON Y 2.5 15. 0.
7 CON Y 2.5 20. 0.
JOINT LOAD
5 FX 1.62
PERFORM ANALYSIS
```

```
          P R O B L E M   S T A T I S T I C S
          -----------------------------------

NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =      8/     7/     4
ORIGINAL/FINAL BAND-WIDTH =     4/     2
TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =     16
SIZE OF STIFFNESS MATRIX =     112 DOUBLE PREC. WORDS
REQRD/AVAIL. DISK SPACE =  12.01/   29.6 MB,  EXMEM = 15.00 MB
```

```
++ PROCESSING ELEMENT STIFFNESS MATRIX.            9:13:18
++ PROCESSING GLOBAL STIFFNESS MATRIX.             9:13:18
++ PROCESSING TRIANGULAR FACTORIZATION.            9:13:18
++ CALCULATING JOINT DISPLACEMENTS.                9:13:18
++ CALCULATING MEMBER  FORCES.                     9:13:19
```

41. PRINT SUPPORT REACTIONS

SUPPORT REACTIONS -UNIT KIP FEET   STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	0.01	5.19	0.00	0.00	0.00	0.00
	2	-0.92	-4.30	0.00	0.00	0.00	0.00
2	1	-0.54	10.89	0.00	0.00	0.00	[illegible]
	2	-0.29	-10.87	0.00	0.00	0.00	0.00
3	1	-0.33	10.58	0.00	0.00	0.00	0.00
	2	-0.58	-11.18	0.00	0.00	0.00	0.00
4	1	-0.76	5.84	0.00	0.00	0.00	0.00
	2	0.17	-6.15	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

42. PRINT MEMBER FORCES ALL

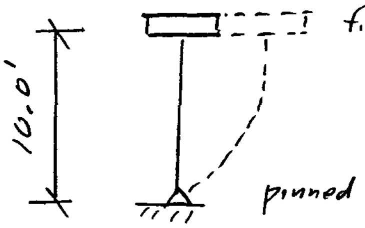
MEMBER END FORCES   STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	5.19	0.00	0.01	0.00	0.00	0.00
		5	-5.19	0.00	-0.01	0.00	-0.12	0.00
	2	1	-4.30	0.00	-0.92	0.00	0.00	0.00
		5	4.30	0.00	0.92	0.00	9.21	0.00
2	1	2	10.89	0.00	-0.54	0.00	0.00	0.00
		6	-10.89	0.00	0.54	0.00	5.42	0.00
	2	2	-10.87	0.00	-0.29	0.00	0.00	0.00
		6	10.87	0.00	0.29	0.00	2.86	0.00
3	1	3	10.58	0.00	-0.33	0.00	0.00	0.00
		7	-10.58	0.00	0.33	0.00	3.28	0.00
	2	3	-11.18	0.00	-0.58	0.00	0.00	0.00
		7	11.18	0.00	0.58	0.00	5.83	0.00
4	1	4	5.84	0.00	-0.76	0.00	0.00	0.00
		8	-5.84	0.00	0.76	0.00	7.63	0.00
	2	4	-6.15	0.00	0.17	0.00	0.00	0.00
		8	6.15	0.00	-0.17	0.00	-1.70	0.00
5	1	5	1.63	5.19	0.00	0.00	0.00	0.12
		6	-1.63	4.81	0.00	0.00	0.00	-21.26
	2	5	0.70	-4.30	0.00	0.00	0.00	-9.21
		6	-0.70	-5.70	0.00	0.00	0.00	23.30
6	1	6	1.09	6.08	0.00	0.00	0.00	15.85
		7	-1.09	3.92	0.00	0.00	0.00	-19.17
	2	6	0.41	-5.17	0.00	0.00	0.00	-26.16
		7	-0.41	-4.83	0.00	0.00	0.00	22.86
7	1	7	0.76	6.66	0.00	0.00	0.00	15.89
		8	-0.76	5.84	0.00	0.00	0.00	-7.63
	2	7	-0.17	-6.35	0.00	0.00	0.00	-28.69
		8	0.17	-6.15	0.00	0.00	0.00	1.70

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT	SHEET NO. 6C	OF
ITEM	BY LEP	DATE
	CHKD. BY	DATE

Columns



$\therefore$ Use $K = 1.2$

Axial Compr $= 11.2^{K}$
$M_x = 25.9^{\,k\text{-}ft}$
$M_y = 9.2^{\,k\text{-}ft}$

Try W12x26, $A = 10.3$
$S_x = 45.6$, $r_y = 1.54$
$S_y = 7.47$, $d/A_f = 3.66$

from STAAD-III $\Delta_{max} = 0.38'' = h/315$ OK

$P\text{-}\Delta = \frac{0.38}{12}(11.2) = 0.36^{\,k\cdot ft} \leftarrow$ add to M_x

$f_a = 11.2/10.3 = 1.09$

$f_{bx} = (25.9+0.36)12/45.6 = 6.91$

$f_{by} = (9.2)12/7.47 = 14.8$

$K\ell/r = 2.1(120)/1.54 = 164 \Rightarrow F_a = 5.58$
$F'_{ex} = 5.58$

$F_{bx} = \frac{12{,}000}{L\, d/A_f} = \frac{12{,}000}{120(3.66)} = 27 > 0.6F_y = 21.6$ ksi

$F_{by} = 0.75 F_y = 27.0$

$$\frac{1.09}{5.58} + \frac{6.91}{(1-1.09/5.58)21.6} + \frac{14.8}{(1-1.09/5.58)27.0} = 1.27 < 1.33 \ \underline{OK}$$

$$\frac{1.09}{0.6(36)} + \frac{6.91}{21.6} + \frac{14.8}{27.0} = 0.92 < 1.33 \ \underline{OK}$$

Use W12x35

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT	SHEET NO. 6 D	OF
ITEM	BY LEP	DATE
	CHKD. BY	DATE

Uplift $= 11{,}200/2 = 5{,}600$ lb/bolt

Ref = ACI 350

$T_{allow} \le 0.5 A_b \sqrt{f'_c}$

$\le 0.2 A_b f_y$

Try A307 bolts, $f_y = 60$ ksi

$0.2\left(\frac{\pi}{4}\right)d^2(60{,}000) \ge 5{,}600$

$\therefore$ Req $d \ge 0.77''$ Try 7/8" dia. A307

[Note = AISC permits 20 ksi tension in A307]

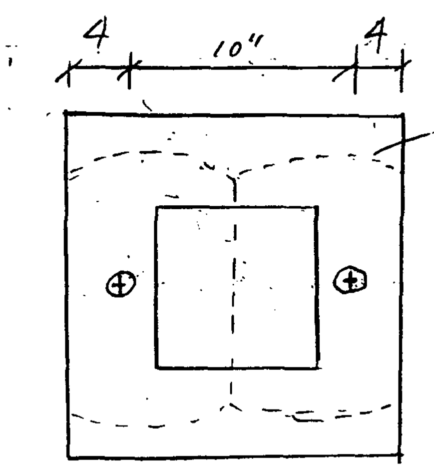
Try 3000 psi concrete

$0.5 A_b \sqrt{3000} \ge 5{,}600$

$\therefore$ Req $A_b \ge 204 \text{ in}^2$

If edge dist. & spacing not a problem

Req $\ell_b \ge \sqrt{\frac{204}{\pi}} = 8.07''$



$A_b \approx 160 \text{ in}^2$ NG

(For 10" embed)

#5 bars, develop $= \frac{0.31(60{,}000)}{21(FS)} = 440$ lb/in (w/ FS = 2)

$\therefore$ Lap bolts 11" w/ #5

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OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO		SHEET NO. 7	OF
ITEM		BY LEP	DATE Dec 95
		CHKD. BY	DATE

Lateral Wind Load Long. $= 2(1.62) = 3.24^K$

Lateral Wind Load Transv $= 60(0.14) = 8.40^K$

Seismic Base Shear $= 0.11 \times$ Weight (Sheet 2)

Metal Deck $(2 psf)(2{,}100 ft^2) =$ 4,200

Metal Roof $(3 psf)(2{,}100 ft^2) =$ 6,300

LH Joists $(15 plf)(34')(13 joists) =$ 6,600

Joist Grders $(14 plf)(20')(6 joists) =$ 1,700

Columns $(19 plf)(12')(8 cols.) =$ 1,800

20,600 lb

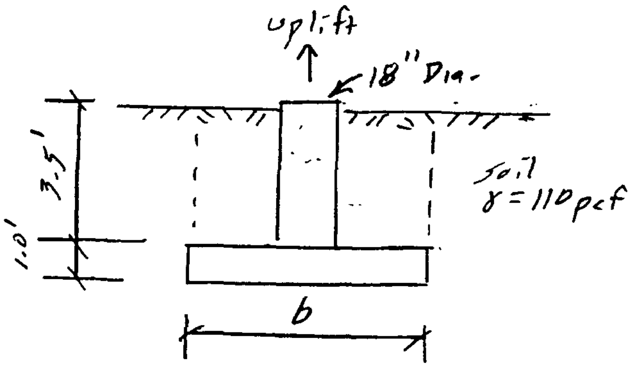
Seismic Base Shear $= 0.11(20.6) = 2.3^K$ < Wind OK

Footing

Frost penetration = 64" Unheated $\}$ ⇒ Req. depth = 4.5'

Max. uplift on column $= 11.2^K$

Req. F.S. > 1.5 ⇒ Req. wt. conc. + soil $> 1.5(11{,}200) = 16{,}800^{lb}$



Pedestal $\pi/4 (1.5)^2(3.5)(150) = 930$

Footing $1.0(b)^2(150) = 150 b^2$

Soil $3.5(b^2 - 1.77)(110) = 385 b^2 - 680$

$Wt. = 535 b^2 + 250 \geq 16{,}800$

Req $b \geq 5.56$

Try $6' \times 6' \times 1'$ footing.

wt. conc. + soil $= 19{,}500^{lb}$ OK

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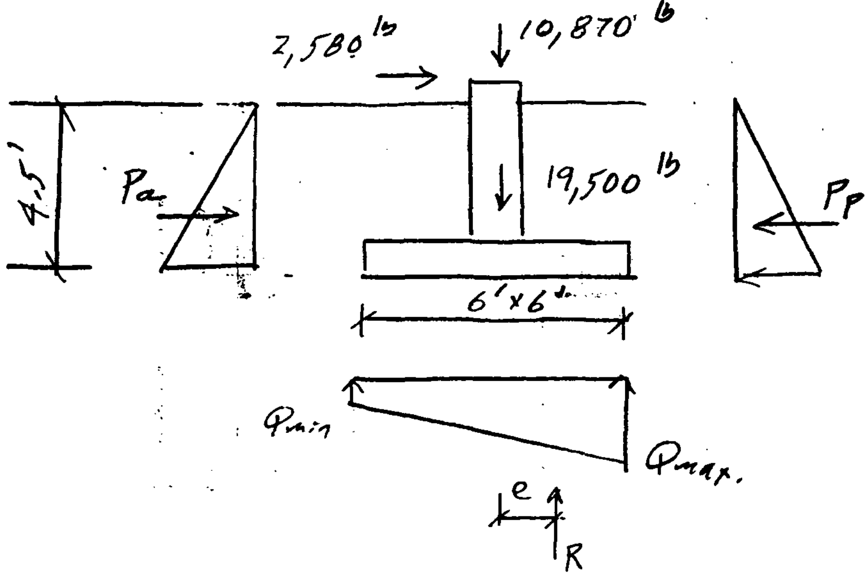
OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS
PROJECT HIMCO	SHEET NO. 6	OF
ITEM	BY LEP	DATE Dec 95
	CHKD. BY	DATE

Check max. load on footing w/ max. lateral load.



pedestal width

$P_a = 0.33(110)(4.5)^2/2 = 367$ plf $\qquad 367 \times 1.5 = 550$ lb

$P_p = 2.7(110)(4.5)^2/2 = 3{,}000$ plf $\qquad 3000 \times 1.5 = 4500$ lb

$$F.S._{sliding} = \frac{4500}{2{,}580 + 550} = 1.4 \quad \underline{\underline{OK}}$$

$$F.S._{overturning} = \frac{(10{,}870 + 19{,}500)(3.0) + (4{,}500)(1.5)}{(2{,}580)(4.5) + 550(1.5)} = 7.9 \quad \underline{\underline{OK}}$$

$R = 10{,}870 + 19{,}500 = 30{,}400$ lb

$M = 2580(4.5) + 550(1.5) - 4500(1.5) = 5{,}690$ ft lb

$$e = \frac{5{,}690}{30{,}400} = 0.19 \text{ ft}$$

$$Q_{max,min} = \frac{R}{A}\left(1 \pm \frac{6e}{L}\right) = \frac{30{,}400}{(6)^2}\left(1 \pm \frac{6(0.19)}{6}\right)$$

$Q_{max,min} = 680$ psf, $1{,}000$ psf $\underline{\underline{OK}}$

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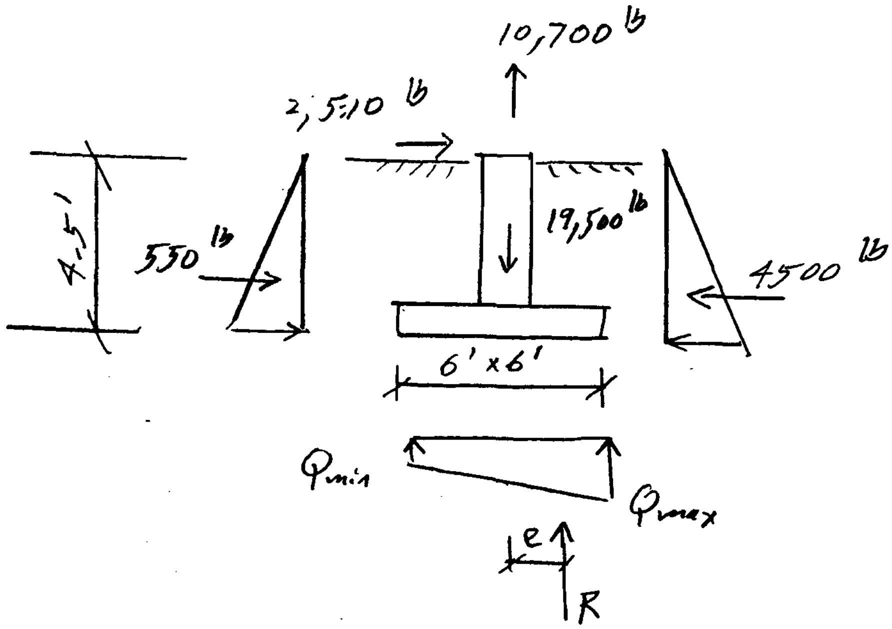
OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO		SHEET NO. 9	OF
ITEM		BY LEP	DATE Dec 95
		CHKD. BY	DATE



$$F.S.\ Sliding = \frac{4500}{2510 + 550} = 1.5\ \underline{\underline{OK}}$$

$$F.S.\ Overturning = \frac{(19{,}500 - 10{,}700)(3.0) + (4{,}500)(1.5)}{(2510)(4.5) + (550)(1.5)} = 2.7\ \underline{\underline{OK}}$$

$$R = 19{,}500 - 10{,}700 = 8{,}800^{lb}$$

$$M = 2{,}510(4.5) + 550(1.5) - 4500(1.5) = 5{,}370^{ft\text{-}lb}$$

$$e = \frac{5{,}370}{8800} = 0.61$$

$$q_{max,\,min.} = \frac{P}{A}\left(1 \pm \frac{6e}{L}\right) = \frac{8{,}800}{(6)^2}\left(1 \pm \frac{6(0.61)}{6}\right)$$

$$q_{max,\,min.} = 95\ psf,\ 390\ psf\ \ \underline{\underline{OK}}$$

$$Pedestal\ M_u = 1.7\,(2.51)(3.5) = 14.9^{k\text{-}ft}$$

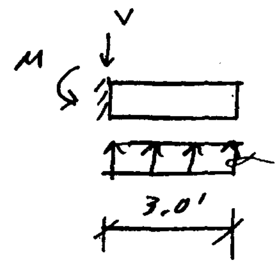
Use $A_{s\,min}$ = 3-#5 ea. side

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO		SHEET NO. 10	OF
ITEM		BY LEP	DATE Dec 95
		CHKD. BY	DATE

Check Punching shear of footing

$V_u = 1.7(11,200) = 19,000^{lb}$

$\phi V_c = 0.85(2)\sqrt{3,000}(9)\pi(18) = 47,300^{lb}$ OK



conservatively design for 1500 psf

$V_u = 1.7(1500)(3.0) = 7,700$ plf

$\phi V_c = 0.85(2)\sqrt{3000}(12)(9) = 10,100$ plf OK

$M_u = 1.7(1.5)(3.0)^2/2 = 11.5^{k\text{-}ft}/ft$

Try $A_{s\,min} = 0.0033(12)(8.5) = 0.34^{in^2}/ft$

Try #5@10", $\phi M_n = 0.9(0.37)(60)\left(8.5 - \frac{0.54}{2}\right)\frac{1}{12} = 13.7$ OK

Use 6'×6'×1' Ftg.
w/ #5@10" EA. WAY, T&B

Column Anchor Bolts $P = 11.2^k$

2-anchors ⇒ Tension $= 11.2/2 = 5.6^k$

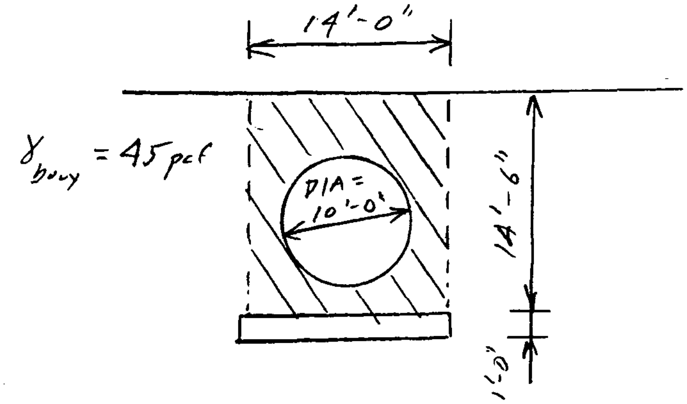
Ref: Dept. of Army, Tech. Manual 5-809-3

1" bolt w/ 9" embed in 3000 psi concrete

w/ 6" edge distance, $T_{allow} = 5.65^k$ OK

∴ Must use 18"×18" pedestal
to provide edge distance

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT		SHEET NO. 11	OF
ITEM		BY LEP	DATE
		CHKD. BY	DATE



$Uplift = 62.4\left(\frac{\pi}{4}\right)(10)^2 = 4,900$ plf

$Wt. Soil = 45\left[(14)(14.5) - \frac{\pi}{4}(10)^2\right] = 5,600$ plf

$Wt. Conc. = 14(150 - 62.4) = 1,230$ plf

$F.S._{uplift} = \frac{5,600 + 1,230}{4,900} = 1.4$ OK

$\frac{5600 + 1230}{14} = 490$ psf downward on slab

$V_u = 1.7(490)(^{14}/_2) = 5,830$ plf

$\phi V_c = 0.85(2)\sqrt{4000}(12)(8.5) = 10,900$ plf $> V_u$ OK

$M_u = 1.7(0.49)(14)^2/8 = 20.4$ k-ft/ft

Req $R_N = \frac{20.4(12,000)}{0.9(12)(8.5)^2} = 314$ psi $\Rightarrow$ Req $\rho = 0.00550$

Req $A_s = 0.00550(12)(8.5) = 0.56$

Try #5 @ 6", $\phi M_n = 0.9(0.62)(60)\left[8.5 - \frac{1.22}{2}\right]\frac{1}{12} = 22.0 > M_u$

OK

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OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT		SHEET NO. 12	OF
ITEM		BY LEP	DATE
		CHKD. BY	DATE

Concrete Slab   Live Load = AASHTO H20 Truck

Ref: AFM 88-3 Ch 15

Design Index = 9

$f'_c = 3{,}000$ psi $\Rightarrow f_r = 7.5\sqrt{f'_c} = 411$ psi

Subgrade $k = 75$ pci

$\therefore$ Required $t = 9\frac{1}{2}$ in unreinforced slab

Use 8" w/ #4 @ 12" ea. way.

APPENDIX J

REMEDIAL ACTION
HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX J
MECHANICAL DESIGN CALCULATIONS

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO SUPERFUND SITE		SHEET NO. 1	OF 1
ITEM GAS RATE		BY RAS	DATE 11/95
		CHKD. BY	DATE

Per para 2.5.4, pg 2-4, of 30% Design Analysis, the estimated annual methane production is 287 Million FT^3/year.

$$\therefore \frac{287 \times 10^6 \text{ FT}^3 \text{ CH}_4}{{}^{*}50\% \text{ CH}_4 \text{ year}} \times \frac{\cancel{365}\ \text{year}}{\cancel{3}\ 365 \text{ day}} \times \frac{1 \text{ day}}{24 \text{ HR}} \times \frac{\text{HR}}{60 \text{ Min}}$$

Total GAS Rate } = 1092 CFM → Use 1100 CFM FOR TOTAL GAS RATE

* Note that landfill gas is about 50% CH_4 & 50% CO_2 per page 2-3 of 30% Design Analysis, para 2.5.1

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO SUPERFUND SITE		SHEET NO. 1	OF 1
ITEM CONDENSATE RATE		BY RKK	DATE 11/95
		CHKD. BY	DATE

Assume landfill gas @ 110°F

Per last pg (E-19) of ▲ETL 1110-1-160

173 CFM yields ⊛91.66 gallons/day

$\therefore$ 1100 CFM $\times \frac{91.66}{173} = 582 \rightarrow$ Use 600 Gallon/Day

⊛ETL says very conservative approach for calculating condensate rate.

▲ ETL "LANDFILL OFF-GAS COLLECTION & TREATMENT SYSTEMS", dated 17 Apr 95

(ETL # 1110-1-160)

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☆ U.S.G.P.O.: 1995-657-136

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO SUPERFUND SITE		SHEET NO. 1	OF 1
ITEM PRESSURE DROP CALCULATIONS		BY RLG	DATE 11/95
		CHKD. BY	DATE

SUCTION SIDE

15" W.C. - Well Head
10" W.C. - Piping
4" W.C. - Moist. Sep.
5" W.C. - Filter
34" W.C. Suction Drop

PRESSURE SIDE

20" W.C. - Flowmeter
15" W.C. - Aftercooler
7.5" W.C. - Carbon Absorb #1
7.5" W.C. - Carbon Absorb #2
20" W.C. - Flame Arrestor
5" W.C. Flare
75" W.C. Press. Side Drop

∴ Total Drop = 109" W.C.

ROTRON BLOWER MODEL EN 14
Max 140" W.C. @ 550 CFM on Pressure Side
Min -85" W.C. @ 550 CFM on Suction Side
30HP Explosion Proof Motor

32" X 24" Foot Print

MRO Form 1550, 1 DEC 83

☆ U.S.G.P.O.: 1995-657-136

OMAHA DISTRICT	COMPUTATION SHEET	CORPS OF ENGINEERS	
PROJECT HIMCO SUPERFUND SITE		SHEET NO. 1	OF 1
ITEM AFTERCOOLERS		BY [illegible]	DATE 12/95
		CHKD. BY	DATE

Assume inlet Gases to aftercoolers is 280°F which is the maximum that the blowers can handle before automatically being shut down

GAS prior to entering vapor phase carbon absorbers must be no more than 150°F (and must be above 120°F to ensure that humidity is appropriate for the absorbers).

Set damper controls to maintain 135°F gas discharge temperature.

OMAHA DISTRICT	COMPUTATION SHEET		CORPS OF ENGINEERS
PROJECT HIMCO SUPERFUND SITE		SHEET NO. 1	OF 1
ITEM FREEZE PROOF H_2O CARBON ABSORBER		BY [illegible]	DATE 12/95
		CHKD. BY	DATE

24" ⌀ x 3' Tall

⊛ Surface Area ≈ 26 ft^2

$$U \times A \times \Delta T = \frac{26\ FT^2 \times (50 - -5)}{11} = 130 \frac{BTU}{HR} = 38\ Watts$$

If used R=4 Insulation instead of R=11, would need ≈ 100 watt immersion heater w/ stat to control. This will Keep water in absorber from freezing.

⊛ $(2' \phi \times \pi \times 3' \text{Tall}) + 2 \times \frac{2'\phi^2 \times \pi}{4} = 26\ ft^2$ Surface Area

APPENDIX K

REMEDIAL ACTION
HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX K
ELECTRICAL DESIGN CALCULATIONS

TABLE OF CONTENTS

US ARMY	PROJECT: HIMCO Dump
CORPS OF ENGINEERS	CLIENT: EPA
OMAHA, NEBRASKA	DATE: 13 Dec 1995
ESD INC. LIGHTING PROGRAM	DESIGNER: R.T.L.

GENERAL PROJECT INFORMATION:

PROJECT LOCATION:	Elkhart, IN
DEFAULT HEIGHT OF CEILING CAVITY:	1.00
DEFAULT HEIGHT OF ROOM CAVITY:	5.50
DEFAULT HEIGHT OF FLOOR CAVITY:	2.50
DEFAULT PERCENT CEILING REFLECTANCE:	75
DEFAULT PERCENT WALL REFLECTANCE:	10
DEFAULT PERCENT FLOOR REFLECTANCE:	20
DEFAULT DIRT DEPRECIATION FACTOR:	80

***** LIGHTING FIXTURE CALCULATIONS BY ELITE SOFTWARE DEVELOPMENT INC *****

US ARMY OMAHA, NEBRASKA

HIMCO Dump 13 Dec 1995

*********************** FIXTURE REQUIREMENTS REPORT ***********************

ROOM NO. AND NAME FIX. DESCRIPTION FIX. MANUFACTURER FIX. CATALOG NO.	#TIMES LENGTH WIDTH AREA	HCC CCR PC PCC	HRC RCR PW PFC	HFC FCR PF PFM	LLD LDD TBF LLF	S/MH. #F/ROW # ROWS COEF.U	LUMEN #LAMP WATTS W/SF.	D-FC. D-FIX I-FIX I-FC.
process	1	1.00	5.50	2.50	95	1.40	16000	20.00
304B (150WATT)	60.00	0.25	1.38	0.63	80	2	1	5.98
LITHONIA DOWNLIGHTN	30.00	75.00	10.00	20.00	100	3.00	1260	6.00
GC-15-150S	1800.00	67.90	16.38	0.984	76	50.34	0.70	20.07
process	1	1.00	5.50	2.50	95	1.40	9500	20.00
304C (100WATT)	60.00	0.25	1.38	0.63	80	2	1	10.07
LITHONIA DOWNLIGHTN	30.00	75.00	10.00	20.00	100	5.00	1500	10.00
GC15-100S	1800.00	67.90	16.38	0.984	76	50.34	0.83	19.86

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
ELKHART, INDIANA
US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

DATE: 4 JAN 96
TIME: 2 30 PM

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL, INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY

DAPPER (DEMAND LOAD ANALYSIS MINI/MICRO VERSION 4.0)

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
ELKHART, INDIANA
US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

LOAD SUMMARY

LOAD SCHEDULE FOR 10 SOURCE — 12470. VOLTS LINE TO LINE
SOURCE OF PWR **** SOURCE BUS

ITEM DESCRIPTION	CONNECTED KVA	LOAD AMPS	DEMAND KVA	LOAD AMPS	DESIGN KVA	LOAD AMPS	% P F
BRANCH LOADS							
50 T1 PRIMARY	111.4	5.2	103.3	4.8	114.6	5.3	-81.6
TOTALS	111.4	5.2	103.3	4.8	114.6	5.3	-81.6

LOAD SCHEDULE FOR 50 T1 PRIMARY — 12470. VOLTS LINE TO LINE
SOURCE OF PWR 10 SOURCE

ITEM DESCRIPTION	CONNECTED KVA	LOAD AMPS	DEMAND KVA	LOAD AMPS	DESIGN KVA	LOAD AMPS	% P F
BRANCH LOADS							
100 T1 SECOND	111.4	5.2	103.3	4.8	114.6	5.3	-81.6
TOTALS	111.4	5.2	103.3	4.8	114.6	5.3	-81.6

LOAD SCHEDULE FOR 100 T1 SECOND — 480. VOLTS LINE TO LINE
SOURCE OF PWR 50 T1 PRIMARY

ITEM DESCRIPTION	CONNECTED KVA	LOAD AMPS	DEMAND KVA	LOAD AMPS	DESIGN KVA	LOAD AMPS	% P F
BRANCH LOADS							
1000 PANEL MDP	111.4	134.0	103.3	124.2	114.6	137.8	-81.6
TOTALS	111.4	134.0	103.3	124.2	114.6	137.8	-81.6

LOAD SCHEDULE FOR 1000 PANEL MDP — 480. VOLTS LINE TO LINE
SOURCE OF PWR 100 T1 SECOND

ITEM DESCRIPTION	CONNECTED KVA	LOAD AMPS	DEMAND KVA	LOAD AMPS	DESIGN KVA	LOAD AMPS	% P F
END USE LOADS							
5 SPARE	13.2	15.9	6.6	7.9	8.3	9.9	-85.0
9 MOTOR LOADS	56.0	67.3	56.0	67.3	56.0	67.3	-80.0
10 LARGEST MOTOR	31.7	38.1	31.7	38.1	39.6	47.7	-80.0
BRANCH LOADS							
1010 T2 PRIMARY	10.7	12.9	9.2	11.1	11.2	13.5	-90.8
TOTALS	111.4	134.0	103.3	124.2	114.6	137.8	-81.6

LOAD SUMMARY

****

LOAD SCHEDULE FOR 1010 T2 PRIMARY 480. VOLTS LINE TO LINE
SOURCE OF PWR 1000 PANEL MDP

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
BRANCH LOADS							
1050 T2 SECOND	10.7	12.9	9.2	11.1	11.2	13.5	-90.8
TOTALS	10.7	12.9	9.2	11.1	11.2	13.5	-90.8

LOAD SCHEDULE FOR 1050 T2 SECOND 208. VOLTS LINE TO LINE
SOURCE OF PWR 1010 T2 PRIMARY

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
BRANCH LOADS							
1055 PANEL RCP	10.7	29.7	9.2	25.6	11.2	31.2	-90.8
TOTALS	10.7	29.7	9.2	25.6	11.2	31.2	-90.8

LOAD SCHEDULE FOR 1055 PANEL RCP 208. VOLTS LINE TO LINE
SOURCE OF PWR 1050 T2 SECOND

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
1 GENERAL LOADS	1.3	3.5	1.3	3.5	1.6	4.3	100.0
2 LIGHTING	1.3	3.5	1.3	3.5	1.6	4.4	-95.0
3 RECEPTACLES	1.6	4.4	1.6	4.4	2.0	5.6	-90.0
5 SPARE	3.0	8.3	1.5	4.2	1.9	5.2	-85.0
7 CONTROLS	1.5	4.2	1.5	4.2	1.9	5.2	-90.0
9 MOTOR LOADS	1.2	3.2	1.2	3.2	1.2	3.2	-80.0
10 LARGEST MOTOR	1.1	3.1	1.1	3.1	1.4	3.9	-80.0
TOTALS	10.7	29.7	9.2	25.6	11.2	31.2	-90.8

SOURCE LOAD SUMMARY

****

LOAD BUS 10 SOURCE 12470. VOLTS LINE TO LINE

LOAD DESCRIPTION TYPE	UNITS	CONNECTED LOAD	DEMAND LOAD	DESIGN LOAD	POWER FACTOR %	
1 GENERAL LOADS	KW	1.3	1.3	1.6		
	KVAR	.0	.0	.0		
	KVA	1.3	1.3	1.6	100.0	UNITY
2 LIGHTING	KW	1.2	1.2	1.5		
	KVAR	-.4	-.4	-.5		
	KVA	1.3	1.3	1.6	95.0	LAGGING
3 RECEPTACLES	KW	1.4	1.4	1.8		
	KVAR	-.7	-.7	-.9		
	KVA	1.6	1.6	2.0	90.0	LAGGING
5 SPARE	KW	13.8	6.9	8.6		
	KVAR	-8.5	-4.3	-5.3		
	KVA	16.2	8.1	10.1	85.0	LAGGING
7 CONTROLS	KW	1.3	1.3	1.7		
	KVAR	-.7	-.7	-.8		
	KVA	1.5	1.5	1.9	90.0	LAGGING
9 MOTOR LOADS	KW	46.6	46.6	46.6		
	KVAR	-34.9	-34.9	-34.9		
	KVA	58.2	58.2	58.2	80.0	LAGGING
10 LARGEST MOTOR	KW	25.4	25.4	31.7		
	KVAR	-19.0	-19.0	-23.8		
	KVA	31.7	31.7	39.6	80.0	LAGGING
TOTAL LOADS	KW	91.0	84.1	93.5		
	KVAR	-64.3	-60.0	-66.2		
	KVA	111.4	103.3	114.6		
	% PF	81.7 LAGGING	81.4 LAGGING	81.6 LAGGING		

LOAD DEMAND TABLE

LOAD DESCRIPTION	LOAD TYPE	FIRST DEMAND KVA	FIRST DEMAND %	SECOND DEMAND KVA	SECOND DEMAND %	THIRD DEMAND KVA	THIRD DEMAND %	% PF	DESIGN FACT
1 GENERAL LOADS	Z	ALL	100.	ALL	100.	ALL	100.	100.0	1.25
2 LIGHTING	K	ALL	100.	ALL	100.	ALL	100.	-95.0	1.25
3 RECEPTACLES	K	10.	100.	ALL	50.	ALL	50.	-90.0	1.25
4 OFFICE EQUIP	Z	ALL	100.	ALL	100.	ALL	100.	-85.0	1.25
5 SPARE	Z	ALL	50.	ALL	50.	ALL	50.	-85.0	1.25
6 STANDBY LOADS	K	ALL	100.	ALL	100.	ALL	100.	-85.0	1.25
7 CONTROLS	Z	ALL	100.	ALL	100.	ALL	100.	-90.0	1.25
8 CAPACITORS	Z	ALL	100.	ALL	100.	ALL	100.	.0	1.35
9 MOTOR LOADS	K	ALL	100.	ALL	100.	ALL	100.	-80.0	1.00
10 LARGEST MOTOR	K	ALL	100.	ALL	100.	ALL	100.	-80.0	1.25

NOTES: LOAD TYPE 10 PROVIDES TRANSFER FUNCTION TO LOAD TYPE 9
DEMAND AND DESIGN FACTORS APPLIED AT EACH LOAD BUS
AND ALL LOAD TOTALS ARE POWER FACTOR CORRECTED

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
ELKHART, INDIANA
US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

DATE: 13 DEC 95
TIME: 08 30 AM

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL, INTERPRETATION
AND APPLICATION BY A REGISTERED ENGINEER ONLY

DAPPER (SIZE FEEDERS AND TRANSFORMERS MINI/MICRO VERSION 4.0)

FEEDER AND TRANSFORMER STUDY CRITERIA

FEEDERS AND TRANSFORMERS TO BE SIZED
MASTER FILE WILL NOT BE UPDATED

BRANCH VOLTAGE DROP CRITERIA 2.00

VOLTAGE DROP CALCULATIONS PRESENTED HERE IN ARE PRELIMINARY
EXECUTE VOLTAGE DROP AND LOAD FLOW STUDY FOR MORE COMPLETE RESULTS

PRIMARY/SECONDARY TRANSFORMER FDRS SIZED AT 125. % OF TX FULL LOAD RATING

```
***  NOTICE   ***  FEEDER SIZED TO  125. PERCENT OF TRANSFORMER SIZE
                   BRANCH FROM  100 T1 SECOND  TO 1000 PANEL MDP
                   TR KVA:     118.1  TR FLA:    142.1
                   MINIMUM FEEDER AMPACITY:      177.6

***  NOTICE   ***  FEEDER SIZED TO  125. PERCENT OF TRANSFORMER SIZE
                   BRANCH FROM 1000 PANEL MDP  TO 1010 T2 PRIMARY
                   TR KVA:      15.0  TR FLA:     18.0
                   MINIMUM FEEDER AMPACITY:       22.6

***  NOTICE   ***  FEEDER SIZED TO  125. PERCENT OF TRANSFORMER SIZE
                   BRANCH FROM 1050 T2 SECOND  TO 1055 PANEL RCP
                   TR KVA:      15.0  TR FLA:     41.6
                   MINIMUM FEEDER AMPACITY:       52.0
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HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
ELKHART, INDIANA
US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

FOR MISSING DATA, DAPPER DEFAULTS TO THE FOLLOWING VALUES

FEEDER INSULATION:	THWN	0-600 VOLTS
FEEDER INSULATION:	XLP	601-15000 VOLTS
CIRCUIT DATA:		4 WIRE, NO GROUND
CIRCUIT DATA:		3 WIRE, NO GROUND FOR DELTA AND WYE XFORMERS
FEEDER TYPE:		COPPER
DUCT TYPE:		METALLIC RACEWAY
TRANSFORMER TYPES:	DT	DRY TYPE
PERCENT TAP:	0.0	NO TAP SET
PRIMARY CONNECTIONS:		DELTA
SECONDARY CONNECTIONS:		WYE-GROUNDED

0 DEFAULT VALUES USED IN THIS REPORT

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
ELKHART, INDIANA
US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

FEEDER SCHEDULE DATE:13 DEC 95

FEEDER ROUTING NO NAME	FEEDER VOLTAGE	RACEWAY QTY DESCRIPTION	FEEDER DESCRIPTION QTY SIZE INSUL GRND	FDR LENGTH
FROM 10 SOURCE	12470.			
TO 50 T1 PRIMARY		(1) 2 1/2" C	(3) 6 C XLP 8	450
FROM 100 T1 SECOND	480.			
TO 1000 PANEL MDP		(1) 2" C RG	(4) 3/0 C THWN 6	35
FROM 1000 PANEL MDP	480.			
TO 1010 T2 PRIMARY		(1) 1/2" C RG	(3) 10 C TW 10	25
FROM 1050 T2 SECOND	208.			
TO 1055 PANEL RCP		(1) 1 1/4" C RG	(4) 6 C TW 8	20

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
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US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

FEEDER EVALUATION

FEEDER	ROUTING NO	NAME	EXTG % VD	QTY /PH	SIZE FDR	FEEDER MAT	DESCRIPTION INSUL	AMBIENT	DESIGN LOAD	FEEDER RATING
FROM	10	SOURCE	12470.							
TO	50	T1 PRIMARY	.01	1	6	CU	XLP	30.	5.A	90.A
FROM	100	T1 SECOND	480.							
TO	1000	PANEL MDP	.21	1	3/0	CU	THWN	30.	138.A	200.A
FROM	1000	PANEL MDP	480.							
TO	1010	T2 PRIMARY	.18	1	10	CU	TW	30.	14.A	30.A
FROM	1050	T2 SECOND	208.							
TO	1055	PANEL RCP	.33	1	6	CU	TW	30.	32.A	55.A

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
ELKHART, INDIANA
US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

TRANSFORMER SCHEDULE DATE:13 DEC 95

LOCATION DESCRIPTION BUS NO. NAME	VOLTAGE LEVELS	CONN CODE	PCT TAP	TRANSFORMER DESCRIPTION
FROM 50 T1 PRIMARY TO 100 T1 SECOND DESIGN LOAD: 115.0 KVA	12470. 480.	D YG	.0	TYPE: OA SIZE: 118.1 KVA DESCRIPTION: OIL TO AIR 4.49 %Z NOM. RATING: 112.5 KVA
FROM 1010 T2 PRIMARY TO 1050 T2 SECOND DESIGN LOAD: 11.7 KVA	480. 208.	D YG	.0	TYPE: DT SIZE: 15.0 KVA DESCRIPTION: DRY TYPE 2.78 %Z NOM. RATING: 15.0 KVA

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
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DAPPER (SHORT CIRCUIT PROGRAM MINI/MICRO VERSION 4.0)

C O N T R I B U T I O N   D A T A

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CONTRIBUTION                       VOLTAGE      BASE
FROM NAME         NO  NAME           L-L         MVA        XD"(PU)        X/R

SOURCE            10 SOURCE        12470.    3P-KA:         4.630         30.0
          TYPE: UTILITY                      1P-KA:          .278         30.0
     POS  SEQUENCE IMPEDANCE (100 MVA BASE)          .03331 + J     .99944 PER UNIT
     ZERO SEQUENCE IMPEDANCE (100 MVA BASE)         1.59911 + J   47.97340 PER UNIT

B-2             1000 PANEL MDP        480.        .030         .25000       15.0
          TYPE: IND. MOTOR  kw/HP:      30. RPM: 1800.
     POS  SEQUENCE IMPEDANCE (100 MVA BASE)       55.55556 + J 833.33340 PER UNIT

B-1             1000 PANEL MDP        480.        .030         .25000       15.0
          TYPE: IND. MOTOR  kw/HP:      30. RPM: 1800.
     POS  SEQUENCE IMPEDANCE (100 MVA BASE)       55.55556 + J 833.33340 PER UNIT
```

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
ELKHART, INDIANA
US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

F E E D E R D A T A

FEEDER FROM NO	NAME		FEEDER TO NO	NAME	QTY /PH	VOLTS L-L	LENGTH FEET	FEEDER SIZE	TYPE	DESCRIPTION DUCT	INSUL
10	SOURCE		50	T1 PRIMARY	1	12470.	450.	1	C	N	XLP
	POS	SEQ Z	.1600 + J	.0540 OHMS/M FEET				.04630 + J		.01563 PU	
	0	SEQ Z	.2543 + J	.1373 OHMS/M FEET				.07359 + J		.03973 PU	
100	T1 SECOND		1000	PANEL MDP	1	480.	35.	4/0	C	M	THWN
	POS	SEQ Z	.0640 + J	.0497 OHMS/M FEET				.97222 + J		.75499 PU	
	0	SEQ Z	.2017 + J	.1224 OHMS/M FEET				3.06402 + J		1.85938 PU	
1000	PANEL MDP		1010	T2 PRIMARY	1	480.	25.	8	C	M	TW
	POS	SEQ Z	.8110 + J	.0754 OHMS/M FEET				8.79991 + J		.81814 PU	
	0	SEQ Z	2.5559 + J	.1856 OHMS/M FEET				27.73329 + J		2.01389 PU	
1050	T2 SECOND		1055	PANEL RCP	1	208.	20.	6	C	M	TW
	POS	SEQ Z	.5100 + J	.0685 OHMS/M FEET				23.57618 + J		3.16660 PU	
	0	SEQ Z	1.6072 + J	.1687 OHMS/M FEET				74.29734 + J		7.79863 PU	

T R A N S F O R M E R   D A T A

PRIMARY SIDE NO	NAME	CONN	VOLTS L-L	PRI FLA	*	SECONDARY SIDE NO	NAME	CONN	VOLTS L-L	SEC FLA	NOMINAL KVA
50	T1 PRIMARY	D	12470.	7.		100	T1 SECOND	YG	480.	180.	150.0
	POS SEQ Z		1.9400 + J 4.0700 PERCENT				12.93333 + J 27.13334 PER UNIT				
	0 SEQ Z		1.9400 + J 4.0700 PERCENT				.1293E+02 + J .2713E+02 PER UNIT				
1010	T2 PRIMARY	D	480.	18.		1050	T2 SECOND	YG	208.	42.	15.0
	POS SEQ Z		2.1000 + J 1.8200 PERCENT				140.00000 + J 121.33330 PER UNIT				
	0 SEQ Z		2.1000 + J 1.8200 PERCENT				.1400E+03 + J .1213E+03 PER UNIT				

THREE PHASE FAULT REPORT
PRE FAULT VOLTAGE: 1.0000
MODEL TRANSFORMER TAPS: YES

10 SOURCE	FAULT: 4640.	RMS SYM AMPS,	100224. KVA	X/R:	29.879
	VOLTAGE: 12470.	IMPEDANCE TO GND=	.05190 + J	1.55067	OHMS
	CONTRIBUTIONS:	SOURCE	4630. AMPS	X/R:	30.000
		50 T1 PRIMARY	10. AMPS	X/R:	10.654
50 T1 PRIMARY	FAULT: 4558.	RMS SYM AMPS,	98437. KVA	X/R:	12.744
	VOLTAGE: 12470.	IMPEDANCE TO GND=	.12358 + J	1.57485	OHMS
	CONTRIBUTIONS:	10 SOURCE	4547. AMPS	X/R:	12.749
		100 T1 SECOND	10. AMPS	X/R:	10.665
100 T1 SECOND	FAULT: 4149.	RMS SYM AMPS,	3449. KVA	X/R:	2.311
	VOLTAGE: 480.	IMPEDANCE TO GND=	.02653 + J	.06131	OHMS
	CONTRIBUTIONS:	50 T1 PRIMARY	3879. AMPS	X/R:	2.163
		1000 PANEL MDP	287. AMPS	X/R:	14.519
1000 PANEL MDP	FAULT: 4015.	RMS SYM AMPS,	3338. KVA	X/R:	2.217
	VOLTAGE: 480.	IMPEDANCE TO GND=	.02839 + J	.06293	OHMS
	CONTRIBUTIONS:	B-2	144. AMPS	X/R:	15.000
		B-1	144. AMPS	X/R:	15.000
		100 T1 SECOND	3746. AMPS	X/R:	2.067
1010 T2 PRIMARY	FAULT: 3419.	RMS SYM AMPS,	2843. KVA	X/R:	1.332
	VOLTAGE: 480.	IMPEDANCE TO GND=	.04866 + J	.06481	OHMS
	CONTRIBUTIONS:	1000 PANEL MDP	3419. AMPS	X/R:	1.332
1050 T2 SECOND	FAULT: 1263.	RMS SYM AMPS,	455. KVA	X/R:	.928
	VOLTAGE: 208.	IMPEDANCE TO GND=	.06971 + J	.06466	OHMS
	CONTRIBUTIONS:	1010 T2 PRIMARY	1263. AMPS	X/R:	.928
1055 PANEL RCP	FAULT: 1158.	RMS SYM AMPS,	417. KVA	X/R:	.826
	VOLTAGE: 208.	IMPEDANCE TO GND=	.07991 + J	.06603	OHMS
	CONTRIBUTIONS:	1050 T2 SECOND	1158. AMPS	X/R:	.826

U N B A L A N C E D F A U L T R E P O R T
PRE FAULT VOLTAGE: 1.0000
MODEL TRANSFORMER TAPS: YES

LOCATION VOLTAGE	FAULT DUTIES	AMPERES (RMS)	X/R FAULT	EQUIVALENT (PU) IMPEDANCE	ASYM. INTERRUPTING CURRENT (RMS)
10	3 PHASE:	4640.	30.	Z1= .9978	7512. AMPS MOMENTARY
SOURCE	SLG DUTY:	278.	30.	Z2= .9978	5807. AMPS AT 3 CYCLES
12470. VOLTS	LN/LN	4019.		Z0= .4800E+02	5176. AMPS AT 5 CYCLES
	LN/LN/GND	4019.	(	143. GND RETURN A)	4798. AMPS AT 8 CYCLES
50	3 PHASE:	4558.	13.	Z1= 1.0159	6793. AMPS MOMENTARY
T1 PRIMARY	SLG DUTY:	277.	27.	Z2= 1.0159	4788. AMPS AT 3 CYCLES
12470. VOLTS	LN/LN	3947.		Z0= .4804E+02	4590. AMPS AT 5 CYCLES
	LN/LN/GND	3945.	(	143. GND RETURN A)	4559. AMPS AT 8 CYCLES
100	3 PHASE:	4149.	2.	Z1= 28.9935	4414. AMPS MOMENTARY
T1 SECOND	SLG DUTY:	4099.	2.	Z2= 28.9935	4149. AMPS AT 3 CYCLES
480. VOLTS	LN/LN	3593.		Z0= .3006E+02	4149. AMPS AT 5 CYCLES
	LN/LN/GND	4167.	(	4050. GND RETURN A)	4149. AMPS AT 8 CYCLES
1000	3 PHASE:	4015.	2.	Z1= 29.9615	4244. AMPS MOMENTARY
PANEL MDP	SLG DUTY:	3881.	2.	Z2= 29.9615	4015. AMPS AT 3 CYCLES
480. VOLTS	LN/LN	3477.		Z0= .3311E+02	4015. AMPS AT 5 CYCLES
	LN/LN/GND	4041.	(	3754. GND RETURN A)	4015. AMPS AT 8 CYCLES
1010	3 PHASE:	3419.	1.	Z1= 35.1756	3450. AMPS MOMENTARY
T2 PRIMARY	SLG DUTY:	2946.	1.	Z2= 35.1756	3419. AMPS AT 3 CYCLES
480. VOLTS	LN/LN	2961.		Z0= .5361E+02	3419. AMPS AT 5 CYCLES
	LN/LN/GND	3487.	(	2557. GND RETURN A)	3419. AMPS AT 8 CYCLES
1050	3 PHASE:	1263.	1.	Z1= 219.7698	1334. AMPS MOMENTARY
T2 SECOND	SLG DUTY:	1333.	1.	Z2= 219.7698	1333. AMPS AT 3 CYCLES
208. VOLTS	LN/LN	1094.		Z0= .1853E+03	1333. AMPS AT 5 CYCLES
	LN/LN/GND	1314.	(	1411. GND RETURN A)	1333. AMPS AT 8 CYCLES
1055	3 PHASE:	1158.	1.	Z1= 239.6005	1159. AMPS MOMENTARY
PANEL RCP	SLG DUTY:	1144.	1.	Z2= 239.6005	1158. AMPS AT 3 CYCLES
208. VOLTS	LN/LN	1003.		Z0= .2502E+03	1158. AMPS AT 5 CYCLES
	LN/LN/GND	1199.	(	1128. GND RETURN A)	1158. AMPS AT 8 CYCLES

F A U L T   S T U D Y   S U M M A R Y

PRE FAULT VOLTAGE: 1.0000

MODEL TRANSFORMER TAPS: YES

BUS RECORD NO	NAME	VOLTAGE L-L	AVAILABLE FAULT DUTIES 3 PHASE	LINE/GRND
10	SOURCE	12470.	4640.	278.
50	T1 PRIMARY	12470.	4558.	277.
100	T1 SECOND	480.	4149.	4099.
1000	PANEL MDP	480.	4015.	3881.
1010	T2 PRIMARY	480.	3419.	2946.
1050	T2 SECOND	208.	1263.	1333.
1055	PANEL RCP	208.	1158.	1144.

7 BUSES, 9 BRANCHES, 3 CONTRIBUTIONS
UNBALANCED FAULTS REQUESTED
*** SHORT CIRCUIT STUDY COMPLETE ***

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
ELKHART, INDIANA
US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

DATE: 13 DEC 95
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DAPPER (LOAD FLOW AND VOLTAGE DROP MINI/MICRO VERSION 4.0)

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
ELKHART, INDIANA
US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

F E E D E R   D A T A

FEEDER FROM NO	FEEDER FROM NAME	FEEDER TO NO	FEEDER TO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE	FEEDER TYPE	DESCRIPTION DUCT	DESCRIPTION INSUL
10	SOURCE	50	T1 PRIMARY	1	12470.	450. FT	1	C	N	XLP
	IMPEDANCE:	.1600 + J .0540 OHMS/M FEET								
100	T1 SECOND	1000	PANEL MDP	1	480.	35. FT	4/0	C	M	THWN
	IMPEDANCE:	.0640 + J .0497 OHMS/M FEET								
1000	PANEL MDP	1010	T2 PRIMARY	1	480.	25. FT	8	C	M	TW
	IMPEDANCE:	.8110 + J .0754 OHMS/M FEET								
1050	T2 SECOND	1055	PANEL RCP	1	208.	20. FT	6	C	M	TW
	IMPEDANCE:	.5100 + J .0685 OHMS/M FEET								

SOURCE BUS THEVENIN EQUIVALENT IMPEDANCE: .051804860 + J 1.554146000 OHMS
Calculated From Largest Utility Contribution at a Source Location

T R A N S F O R M E R   D A T A

PRIMARY RECORD NO	NAME	VOLTS L-L	PRI FLA	*	SECONDARY RECORD NO	NAME	VOLTS L-L	SEC FLA	NOMINAL KVA
50	T1 PRIMARY	12470.	7.		100	T1 SECOND	480.	180.	150.0
	IMPEDANCE:	1.9400 + J 4.0700 PERCENT					TRANSFORMER FIXED TAP:		-2.5 %
1010	T2 PRIMARY	480.	18.		1050	T2 SECOND	208.	42.	15.0
	IMPEDANCE:	2.1000 + J 1.8200 PERCENT							

B R A N C H   L O A D   D A T A

FROM BUS / TO BUS	BR. TYPE	CONSTANT KVA KVA	CONSTANT KVA %PF	CONSTANT Z KVA	CONSTANT Z %PF	CONSTANT I KVA	CONSTANT I %PF	FLOW DIR.
10 SOURCE / 50 T1 PRIMARY	FEEDER	91	-80.4	11	-88.6			
100 T1 SECOND / 1000 PANEL MDP	FEEDER	91	-80.4	11	-88.6			
1000 PANEL MDP / 1010 T2 PRIMARY	FEEDER	3	-89.4	5	-92.5			
1050 T2 SECOND / 1055 PANEL RCP	FEEDER	3	-89.4	5	-92.5			
50 T1 PRIMARY / 100 T1 SECOND	TRANS.	91	-80.4	11	-88.6			
1010 T2 PRIMARY / 1050 T2 SECOND	TRANS.	3	-89.4	5	-92.5			

*** SOLUTION COMMENTS ***
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SOLUTION PARAMETERS

PER UNIT DRIVING VOLTAGE	:	1.0000
BRANCH VOLTAGE CRITERIA	:	2.00 %
BUS VOLTAGE CRITERIA	:	5.00 %
EXACT(ITERATIVE) SOLUTION	:	YES
TRANSFORMERS MODELED	:	YES

<<PERCENT VOLTAGE DROPS ARE BASED ON NOMINAL DESIGN VOLTAGES>>

TOF SIZE: 25

LARGEST LOAD:		87.66 KVA	
CONVERGENCE CRITERIA:		.004 KVA	
LARGEST BUS MISMATCH	1000	PANEL MDP	.610 KVA
LARGEST BUS MISMATCH	1000	PANEL MDP	.022 KVA
LARGEST BUS MISMATCH	1000	PANEL MDP	.001 KVA

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    BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS (SPECIAL BUS LOAD REPORT)
*******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED      TRANSFORMER VOLTAGE DROP MODELED
VOLTAGE DROP CRITERIA: BRANCH =  2.00 %     BUS =  5.00
PER UNIT DRIVING VOLTAGE = 1.0000


LOAD BUS:    10 SOURCE     DESIGN VOLTAGE: 12470 LOAD VOLTAGE: 12462 %VD:    .1
-------------------------                         VOLTAGE ANGLE:     .0 DEGREES
LOAD   TO:    50 T1 PRIMARY   FEEDER AMPS:      5 VOLTAGE DROP:    1. %VD:  .00
PROJECTED POWER FLOW:     86. KW     63. KVAR   106. KVA    PF:    .81   LAGGING
LOSSES THRU FEEDER:        0. KW       0. KVAR       0. KVA

LOAD FROM: **** SOURCE        FEEDER AMPS:      5 VOLTAGE DROP:    0. %VD:  .00
PROJECTED POWER FLOW:     86. KW     63. KVAR   106. KVA    PF:    .81   LAGGING
LOSSES THRU FEEDER:        0. KW       0. KVAR       0. KVA


LOAD BUS:    50 T1 PRIMARY DESIGN VOLTAGE: 12470 LOAD VOLTAGE: 12461 %VD:    .1
-------------------------                         VOLTAGE ANGLE:     .0 DEGREES
LOAD FROM:    10 SOURCE       FEEDER AMPS:      5 VOLTAGE DROP:    1. %VD:  .00
PROJECTED POWER FLOW:     86. KW     63. KVAR   106. KVA    PF:    .81   LAGGING
LOSSES THRU FEEDER:        0. KW       0. KVAR       0. KVA

LOAD   TO:   100 T1 SECOND    TRANSF AMPS:      5 VOLTAGE DROP:   22. %VD:  .17
PROJECTED POWER FLOW:     86. KW     63. KVAR   106. KVA    PF:    .81   LAGGING
LOSSES THRU TRANSF:       1.4 KW     2.9 KVAR    3.2 KVA ***XFMR TAPS  -2.5%***


LOAD BUS:   100 T1 SECOND  DESIGN VOLTAGE:   480 LOAD VOLTAGE:   479 %VD:    .2
-------------------------                         VOLTAGE ANGLE:    -.9 DEGREES
LOAD FROM:    50 T1 PRIMARY   TRANSF AMPS:    125 VOLTAGE DROP:    1. %VD:  .17
PROJECTED POWER FLOW:     84. KW     60. KVAR   103. KVA    PF:    .81   LAGGING
LOSSES THRU TRANSF:       1.4 KW     2.9 KVAR    3.2 KVA ***XFMR TAPS  -2.5%***

LOAD   TO: 1000 PANEL MDP     FEEDER AMPS:    125 VOLTAGE DROP:    1. %VD:  .13
PROJECTED POWER FLOW:     84. KW     60. KVAR   103. KVA    PF:    .81   LAGGING
LOSSES THRU FEEDER:        0. KW       0. KVAR       0. KVA


LOAD BUS: 1000 PANEL MDP   DESIGN VOLTAGE:   480 LOAD VOLTAGE:   478 %VD:    .4
-------------------------                         VOLTAGE ANGLE:    -.9 DEGREES
               NET BRANCH DIVERSITY LOAD:      76. KW       56. KVAR
LOAD FROM:   100 T1 SECOND    FEEDER AMPS:    125 VOLTAGE DROP:    1. %VD:  .13
PROJECTED POWER FLOW:     84. KW     60. KVAR   103. KVA    PF:    .81   LAGGING
LOSSES THRU FEEDER:        0. KW       0. KVAR       0. KVA
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    BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS (SPECIAL BUS LOAD REPORT)
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED      TRANSFORMER VOLTAGE DROP MODELED
VOLTAGE DROP CRITERIA: BRANCH =  2.00 %    BUS =  5.00
PER UNIT DRIVING VOLTAGE = 1.0000


LOAD   TO: 1010 T2 PRIMARY   FEEDER AMPS:    11 VOLTAGE DROP:    0. %VD:  .08
PROJECTED POWER FLOW:      8. KW     4. KVAR     9. KVA    PF:   .91   LAGGING
LOSSES THRU FEEDER:        0. KW      0. KVAR      0. KVA


LOAD BUS: 1010 T2 PRIMARY DESIGN VOLTAGE:   480 LOAD VOLTAGE:   478 %VD:   .4
-------------------------                      VOLTAGE ANGLE:   -.9 DEGREES
LOAD FROM: 1000 PANEL MDP    FEEDER AMPS:    11 VOLTAGE DROP:    0. %VD:  .08
PROJECTED POWER FLOW:      8. KW     4. KVAR     9. KVA    PF:   .91   LAGGING
LOSSES THRU FEEDER:        0. KW      0. KVAR      0. KVA

LOAD   TO: 1050 T2 SECOND    TRANSF AMPS:    11 VOLTAGE DROP:    8. %VD: 1.65
PROJECTED POWER FLOW:      8. KW     4. KVAR     9. KVA    PF:   .91   LAGGING
LOSSES THRU TRANSF:       .1 KW     .1 KVAR     .2 KVA


LOAD BUS: 1050 T2 SECOND  DESIGN VOLTAGE:   208 LOAD VOLTAGE:   204 %VD:  2.1
-------------------------                      VOLTAGE ANGLE:  -1.2 DEGREES
LOAD FROM: 1010 T2 PRIMARY   TRANSF AMPS:    26 VOLTAGE DROP:    3. %VD: 1.65
PROJECTED POWER FLOW:      8. KW     4. KVAR     9. KVA    PF:   .91   LAGGING
LOSSES THRU TRANSF:       .1 KW     .1 KVAR     .2 KVA

LOAD   TO: 1055 PANEL RCP    FEEDER AMPS:    26 VOLTAGE DROP:    0. %VD:  .21
PROJECTED POWER FLOW:      8. KW     4. KVAR     9. KVA    PF:   .91   LAGGING
LOSSES THRU FEEDER:        0. KW      0. KVAR      0. KVA


LOAD BUS: 1055 PANEL RCP  DESIGN VOLTAGE:   208 LOAD VOLTAGE:   203 %VD:  2.3
-------------------------                      VOLTAGE ANGLE:  -1.1 DEGREES
               NET BRANCH DIVERSITY LOAD:      8. KW      4. KVAR
LOAD FROM: 1050 T2 SECOND    FEEDER AMPS:    26 VOLTAGE DROP:    0. %VD:  .21
PROJECTED POWER FLOW:      8. KW     4. KVAR     9. KVA    PF:   .91   LAGGING
LOSSES THRU FEEDER:        0. KW      0. KVAR      0. KVA


   7 BUSES

*** T O T A L   S Y S T E M   L O S S E S ***
             2. KW       3. KVAR
```

HIMCO DUMP SUPERFUND SITE - GROUNDWATER TREATMENT PLANT
ELKHART, INDIANA
US ARMY CORPS OF ENGINEERS - OMAHA, NEBRASKA

DATE: 4 JAN 96
TIME: 2 30 PM

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED
ENGINEER ONLY

DAPPER (LOAD SCHEDULE SUMMARY MINI/MICRO VERSION 4.0)

DATE: 4 JAN 96 TIME: 2 30 PM PAGE: 2
Panel Schedule 1000 PANEL MDP 3 Phase 4 Wire Voltage LL: 480 Voltage LG: 277

OC Devices: BOLT-ON Device Family: CKT BKR Mounting: SURFACE Enclosure: NEMA 4
Comments: 200A MAIN CKT BKR Bus Rating: 225 Available Fault Duty: 4014 A 3 Phase

Ckt No	Description/ Location	*Load Type	Criteria* Ea	Qty	Dem	Total VA	Remarks	Device Amps	P	P H	Device Amps	P	Remarks	Total VA	*Load Type	Criteria* Ea	Qty	Dem	Description/ Location	Ckt No
1	$$T2 PRIMARY	BUS#	1010			3748		40	3	A	80	3		10570	MTR			10	B-1, BLOWER 30 HP	2
	$$T2 PRIMARY	BUS#	1010			3748				B				10570	MTR			10	B-1, BLOWER 30 HP	
	$$T2 PRIMARY	BUS#	1010			3748				C				10570	MTR			10	B-1, BLOWER 30 HP	
3	B-2, BLOWER 50 HP	MTR			9	10570		80	3	A	20	3	NOTE 1	4040	MTR	2020	2	9	AC-1, COOLER 5 HP	4
	B-2, BLOWER 50 HP	MTR			9	10570				B				4040	MTR	2020	2	9	AC-1, COOLER 5 HP	
	B-2, BLOWER 50 HP	MTR			9	10570				C				4040	MTR	2020	2	9	AC-1, COOLER 5 HP	
5	AC-2, COOLER 5 HP	MTR	2020	2	9	4040	NOTE 1	20	3	A	20	3		2200	SP			5	SPARE	6
	AC-2, COOLER 5 HP	MTR	2020	2	9	4040				B				2200	SP			5	SPARE	
	AC-2, COOLER 5 HP	MTR	2020	2	9	4040				C				2200	SP			5	SPARE	
7	SPARE	SP			5	2200		20	3	A									BLANK	8
	SPARE	SP			5	2200				B									BLANK	
	SPARE	SP			5	2200				C									BLANK	
9	BLANK									A									BLANK	10
	BLANK									B									BLANK	
	BLANK									C									BLANK	

ENDUSE LOADS: PHASE A VA 33620. PHASE B VA 33620. PHASE C VA 33620.
TOTAL LOADS: CONNECTED KVA 111.4 DEMAND KVA 103.3 DESIGN KVA 114.6
CONNECTED FLA 134.0 DEMAND FLA 124.2 DESIGN FLA 137.8

NOTE: 1 THE AFTERCOOLERS HAVE TWO MOTORS WITH EACH MOTOR RATED @ 5 HP.

DATE: 4 JAN 96 TIME: 2 30 PM PAGE: 3

Panel Schedule 1055 PANEL RCP 3 Phase 4 Wire Voltage LL: 208 Voltage LG: 120

OC Devices: BOLT-ON	Device Family: CKT BKR	Mounting: SURFACE	Enclosure: NEMA 4
Comments: 50A MAIN CKT BKR		Bus Rating: 100	Available Fault Duty: 1158 A 3 Phase

Ckt No	Description/ Location	*Load Type	Criteria* Ea	Qty	Dem	Total VA	Remarks	Device Amps	P	PH	Device Amps	P	Remarks	Total VA	*Load Type	Criteria* Ea	Qty	Dem	Description/ Location	Ckt No
1	BV-1. VALVE 0.05 HP	MTR			9	380		20	1	A	20	1		380	MTR			9	BV-2. VALVE 0.05 HP	2
3	BV-3. VALVE 0.5 HP	MTR			10	1130		20	1	B	20	1		1000	CONT			7	FLARE CONTROL PANEL	4
5	TELEPHONE DIALER	CONT			7	500		20	1	C	20	1		1250				1	HEAT TAPE & H-1	6
7	RECEPTACLES	RCPT	200	4	3	800		20	1	A	20	1	SEE NOTE 1	1080	LGTS	180	6	2	LIGHTS PROCESS AREA	8
9	RECEPTACLES	RCPT	200	4	3	800		20	1	B	20	1	SEE NOTE 1	190	LGTS	95	2	2	LIGHTS	10
11	P-1. PUMP _ 0.1 HP	MTR			9	400		20	1	C									BLANK	12
13	SPARE	SP			5	1000		20	1	A									BLANK	14
15	SPARE	SP			5	1000		20	1	B									BLANK	16
17	SPARE	SP			5	1000		20	1	C									BLANK	18

ENDUSE LOADS:	PHASE A VA	3640.	PHASE B VA	4120.	PHASE C VA	3150.
TOTAL LOADS:	CONNECTED KVA	10.7	DEMAND KVA	9.2	DESIGN KVA	11.2
	CONNECTED FLA	29.7	DEMAND FLA	25.6	DESIGN FLA	31.2

NOTE 1. THESE CIRCUIT BREAKERS SHALL BE SWITCH RATED.

APPENDIX L

REMEDIAL ACTION

HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX L

RECORD OF DECISION

DECLARATION

SELECTED REMEDIAL ALTERNATIVE
FOR THE
HIMCO DUMP SITE
ELKHART, INDIANA

Statement of Basis and Purpose

This decision document presents the selected remedial action for the Himco Dump Site, Elkhart, Indiana, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

The purpose of this remedy is to eliminate or reduce migration of contaminants to the groundwater and to reduce the risks associated with exposure to the contaminated materials.

The major components of the selected remedy include:

- Construction of a composite barrier, solid waste landfill cover (cap);

- Use of institutional controls on landfill property to limit land and groundwater use;

- Installation of an active landfill gas collection system including a vapor phase carbon system to treat the off-gas from the landfill;

  An enclosed ground flare system will be implemented if landfill gas characterization studies indicate VOC emissions exceed ARARs (Indiana Administrative Code 326 IAC); and

- Monitoring of groundwater to ensure effectiveness of the remedial action and to evaluate the need for future groundwater treatment.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable. However, because treatment of the principal threats of the site was not found to be practicable, this remedy does not satisfy the statutory preference for remedies that reduce the toxicity, mobility, or volume as a principal element. A removal action conducted at the site in 1992 removed drums and waste material from the only hot spot identified in the landfill during the Remedial Investigation. Beyond that, the size of the landfill precludes a final remedy in which contaminants could be excavated and treated effectively.

Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

State Concurrence

The State of Indiana concurs with the selected remedy. The Letter of Concurrence is attached to this ROD.

Valdas V. Adamkus

Valdas V. Adamkus
Regional Administrator

Sept. 30, 1993.

Date

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
We make Indiana a cleaner, healthier place to live

Evan Bayh
Governor
Kathy Prosser
Commissioner

105 South Meridian Street
P.O. Box 6015
Indianapolis, Indiana 46206-6015
Telephone 317-232-8603
Environmental Helpline 1-800-451-6027

'93 AUG -6 P3:04

REGIONA[illegible]

O: WMD
CC: BECK
RA RF

OSF

August 2, 1993

Mr. Valdas Adamkus
Regional Administrator
U.S. Environmental Protection Agency
Region V
77 West Jackson Boulevard
Chicago, IL 60604

RECEIVED
AUG 9 1993
OFFICE OF SUPERFUND
ASSOCIATE
DIVISION DIRECTOR

Dear Mr. Adamkus

Re: Draft Record of Decision
Himco Dump Superfund Site
Elkhart, Indiana

The Indiana Department of Environmental Management (IDEM) has reviewed the United States Environmental Protection Agency's (U.S. EPA's) draft Record of Decision (ROD) for the Himco Dump Superfund site. The IDEM is in full concurrence with the major components of the selected remedy outlined in the draft ROD, which include:

- Construction of a composite barrier, solid waste landfill cover (cap);
- Use of institutional controls on landfill property to limit land and ground water use;
- Installation of an active landfill gas collection system including a vapor phase carbon system to treat the off-gas from the landfill;

  [An enclosed ground flare system will be implemented if landfill gas characterization studies indicate VOC emissions exceed applicable or relevant and appropriate requirements]
- Monitoring of ground water to ensure effectiveness of the remedial action and to evaluate the need for future ground water treatment; and
- Mitigative measures will be taken during remedy construction activities to minimize adverse impacts to the wetland.

L-4

The IDEM also agree, that the selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternate treatment technologies to the maximum extent practicable but does not satisfy the statutory preference for treatment of the hazardous substance present at the site as a principle element. The IDEM would prefer a remedy which removed and treated leachate contained within the waste mass, but agrees with the U.S. EPA that such treatment was not found to be practical or cost effective.

IDEM staff have been working closely with Region V staff in the selection of an appropriate remedy and is satisfied that the selected alternative adequately addresses the public health and welfare, and the environment with regard to the Himco Dump site.

Please be assured that IDEM is committed to accomplish cleanup at all Indiana sites on the National Priorities List and intends to fulfill all obligations required by law to achieve that goal.

Sincerely,

Kathy Prosser

Kathy Prosser
Commissioner

KP:JS:bl
cc: Mary Elaine Gustafson, U.S. EPA
Beverly Kush, U.S. EPA

RECORD OF DECISION

Himco Dump
Elkhart, Indiana

L-6

TABLE OF CONTENTS

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FIGURES AND TABLES

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

Himco Dump

A. SITE LOCATION AND DESCRIPTION

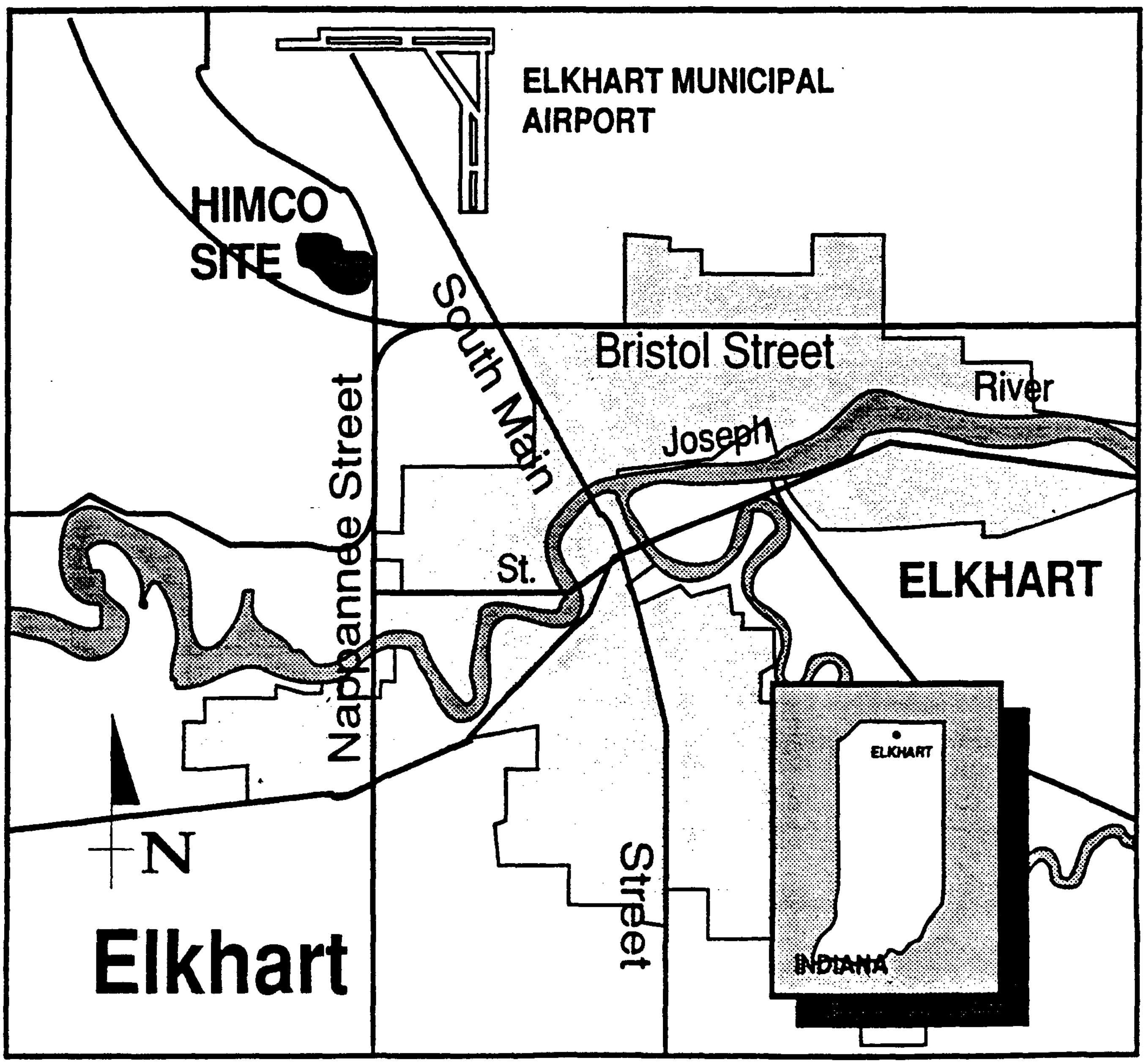
The Himco Dump site is a closed landfill located at County Road 10 and the Nappanee Street Extension in Cleveland Township, adjacent to the City of Elkhart, Elkhart County, Indiana. The site is located approximately two miles north of the St. Joseph River which runs east-west through the City of Elkhart. See Figure 1. The site covers approximately 100 acres and is bounded on the north by a tree line and the northernmost extent of a gravel pit pond; on the south by County Road 10 and private residences; on the east by the Nappanee Street Extension; and a section of land west of two ponds (an L shaped pond called the "L" pond, and the small pond) comprise the western boundary.

The landfill area is covered with a layer of sand, under which is a layer of white, powdery, calcium sulfate. The western half of the landfill cover is vegetated with grasses; the eastern half with grasses, bushes, and young trees. An area south of the landfill and north of County Road 10, the construction debris area, contains many small piles of rubble, concrete, asphalt, and metal debris. The construction debris area extends across the landfill boundary and onto property owned by adjacent landowners.

There was an abandoned gravel pit operation in the northeast corner of the site. An old truck scale and other concrete structures were also present in this area. During an inspection in December, 1992 by the Indiana Department of Environmental Management [IDEM], it was observed that these structures had recently been tampered with and removed. The gravel pit is filled with water which is approximately 30 feet deep. Two smaller and shallower ponds, the L pond and the small pond, are on the west side of the site. See Figure 2.

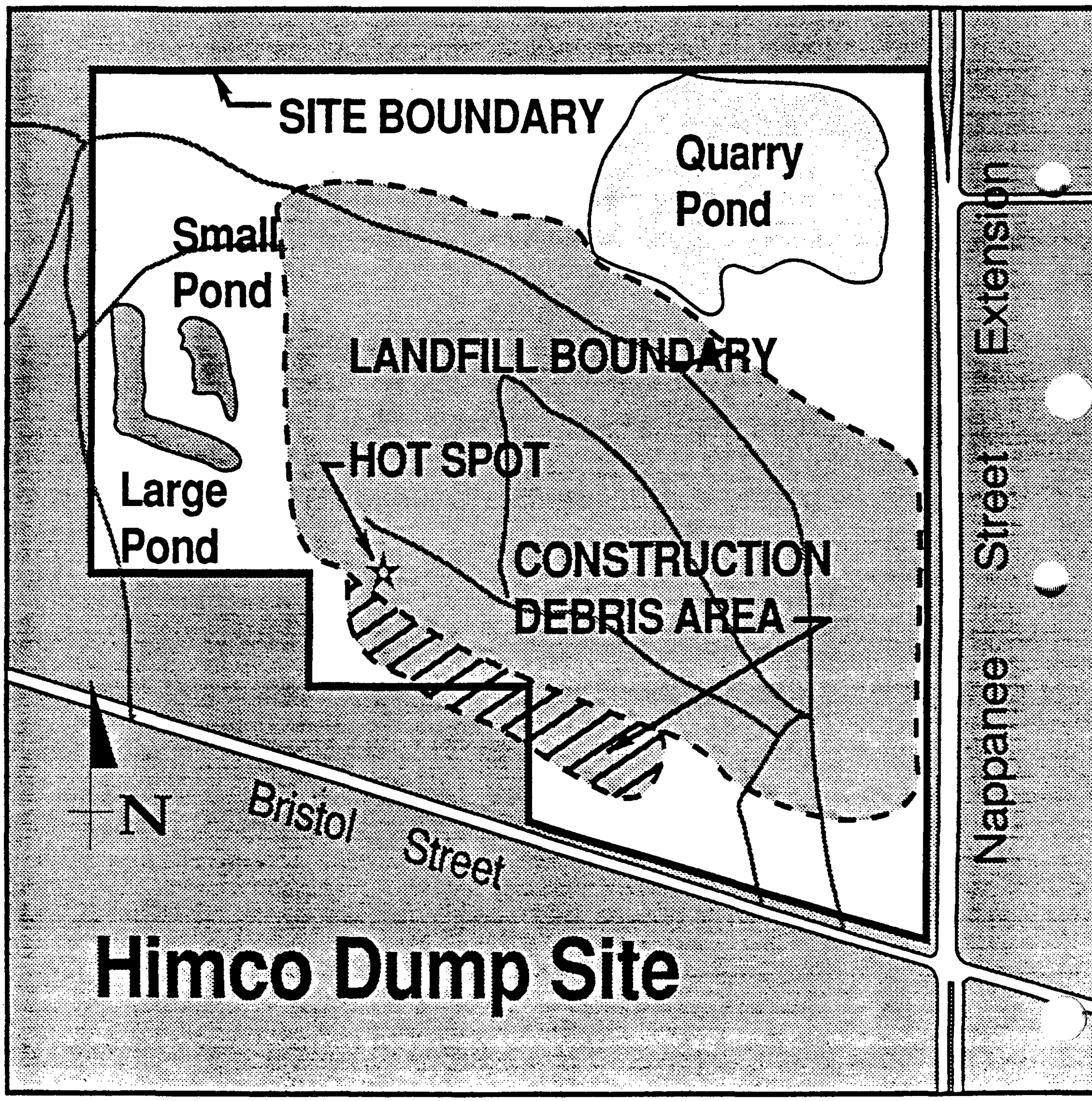
The site is not fenced. In the vicinity of the site are agricultural, residential, and light industrial land uses. There is an access road which leads from the southeast corner of the site near the intersection of County Road 10 and Nappanee Street Extension. A locked gate is present across this road; however, vehicles can easily drive around the gate and enter the site.

FIGURE 1



ELKHART MUNICIPAL AIRPORT
HIMCO SITE
South Main
Bristol Street
River
Joseph
Nappanee Street
St.
ELKHART
ELKHART
INDIANA
N
Street
Elkhart

FIGURE 2



SITE BOUNDARY
Quarry Pond
Small Pond
LANDFILL BOUNDARY
Large Pond
HOT SPOT
CONSTRUCTION DEBRIS AREA
N
Bristol Street
Nappanee Street Extension
Himco Dump Site

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Himco site was privately operated by Himco Waste Away Service, Inc., and was in operation between 1960 and September 1976. As of January 1990, the parcels of land which comprise the landfill were owned by the following individuals or corporations: Miles Inc.; CLD Corporation; Alonzo Craft, Jr.; and Indiana and Michigan Electric Company.

The area was initially a marsh and grassland. There was no liner, no leachate collection, nor gas recovery system constructed as part of the landfill. Refuse was placed at ground surface across the site and in trenches excavated to approximately 10 to 15 feet deep, the width of a truck and 30 feet long, in the eastern area of the site. Solid waste refuse was reportedly dumped in the trenches and burned.

In 1971, the Indiana State Board of Health (ISBH) first identified the Himco site as an open dump. In early 1974, residents along County Road 10 south of the Himco site complained to ISBH about color, taste, and odor problems with their shallow wells. Analyses were conducted from samples of six shallow wells along County Road 10, ranging in depth from 20 to 30 feet. These samples showed the wells were highly contaminated with manganese. Mr. Chuck Himes, the principal landfill operator, replaced these wells with deeper wells ranging in depth from 152 to 172 feet below ground surface. By mid 1990, the wells showed high concentrations of sodium which posed a chronic health threat to the residents. By November 1990, municipal water service was provided to those residents whose wells were affected. The cost of this action was financed by Miles Inc. and Himco Waste-Away Service, Inc.

In 1976, the landfill was closed and covered with approximately one foot of sand overlying a calcium sulfate layer.

In 1984, a U.S. EPA field investigation team conducted a site inspection. Analyses from monitoring wells showed that the groundwater downgradient of the site was contaminated by volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals. During the site inspection, leachate seeps were observed.

In June 1988, the Himco site was proposed for the National Priorities List (NPL) and in February 1990, was officially placed on the NPL and designated a Superfund site. The site Remedial Investigation/Feasibility Study (RI/FS) was begun in 1989 and completed in 1992.

During the Remedial Investigation (RI), a "hot spot" (an isolated area of highly concentrated contaminants) was identified at the southwest border of the landfill. See Figure 2. This area showed high levels of VOCs contamination. On May 22, 1992, U.S. EPA initiated an emergency removal action, which located and removed 71 55-gallon drums containing VOCs such as toluene and ethylbenzene. Although other hot spots have not been identified, it is not certain whether additional pockets of drums exist.

C. HIGHLIGHTS OF COMMUNITY PARTICIPATION

U.S. EPA issued a fact sheet to the public in July 1990, at the beginning of the RI. The Agency also hosted a public meeting on July 12, 1990, to provide background on the Himco Dump site, explain the Superfund process, and provide details of the upcoming investigation. U.S. EPA issued a second fact sheet in May 1992, to notify residents in the vicinity of the site of the "hot spot" assessment and possible emergency removal action (this action was conducted, as stated above).

The RI/FS reports and the Proposed Plan for the Himco Dump site were released to the public for review in September, 1992. Information repositories have been established at the two following locations: the Elkhart Public Library Reference Department, 300 South Second Street, Elkhart, In 46516; and the Pierre Moran Branch Library, 2400 Benham Avenue, Elkhart, IN 46517. The Administrative Record has been made available to the public at the U.S. EPA Docket Room in Region V and at the two libraries.

A public meeting was held on October 6, 1992 to discuss the FS and the Proposed Plan. At this meeting, representatives from the U.S. EPA and IDEM answered questions about the Site and the remedial alternatives under consideration. Formal oral comments on the Proposed Plan were documented by a court reporter. A verbatim transcript of this public meeting has been placed in the information repositories and administrative record. Written comments were also accepted at this meeting. The meeting was attended by approximately 70 persons, including local residents and PRPs.

The FS and Proposed Plan were available for public comment from September 30, 1992 through November 30, 1992. Comments received during the public comment period and the U.S. EPA's responses to those comments are included in the attached Responsiveness Summary, which is a part of this ROD. Advertisements announcing the availability of the Proposed Plan, start of the comment period and extension of the comment period were published in the Elkhart Truth.

The public participation requirements of CERCLA sections 113 (k) (2) (i-v) and 117 of CERCLA have been met in the remedy selection process. This decision document presents the selected remedial action for the Himco Dump site chosen in accordance with CERCLA, as amended by SARA and, to the extent practicable, the National

Contingency Plan (NCP). The decision for this Site is based on the administrative record.

D. SCOPE OF THE SELECTED REMEDY

This ROD addresses the final remedy for the Site. The threats posed by this Site to human health and the environment result from source material in the landfill and from surface and subsurface soil in the southern portion of the landfill (referred to as the construction debris area) and in an area immediately south of the landfill. This response action will contain the source material and will be conducted in accordance with applicable or relevant and appropriate requirements of Federal and State law. U.S. EPA considers containment of the landfill material, which is a potential source of groundwater contamination, to be the most practicable remedy.

This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for the site. However, because treatment of the principal threats of the site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy. The size of the landfill and the fact that it is not known where or if any remaining on-site hot spots exist that represent the major sources of contamination, preclude a remedy in which contaminants could be excavated and treated effectively.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a five year review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment.

E. SUMMARY OF CURRENT SITE CONDITIONS

The RI performed at the Himco Dump Site was designed to characterize the nature and extent of contamination posed by hazardous materials at the site and to conduct a human health risk and ecological assessment. The RI included sampling and analysis of groundwater, surface and subsurface soils, waste mass gas under the landfill cover, leachate collected from within the landfill, and surface water and sediments from the three ponds on the site (quarry pond, L-pond and small pond).

Based on the results of the RI, U.S. EPA has determined that the threats to human health and the environment are through future exposure by ingestion, inhalation or direct contact to VOCs, SVOCs and inorganic compounds through soil and groundwater pathways at the site. U.S. EPA has also determined that there is a significant potential for contamination of the aquifer because of the lack of any adequate natural or man-made barrier to impede leachate flow into the aquifer.

The following conditions were observed at the site:

1. Topography

The Himco Site is located in Elkhart County, Indiana. Elkhart County lies in the Great Lakes section of the Central Lowlands Physiographic Province. The present topography is a result of continental glaciation. The land surface consists of nearly level and gently sloping eolian and outwash sands in the northern part of the county; level to moderately sloping outwash terraces and plains in the northern and central portions of the county; and nearly level to strongly sloping glacial till plains in the eastern and western portions.

The land surface elevation in Elkhart County ranges from 950 feet in the southeast to 740 feet Mean Sea Level (MSL) in the west at the St. Joseph River (USGS, 1981).

2. Geology

The general site area is characterized as sand and gravel outwash deposits, comprised of alternating beds, varying in thickness, of poorly- to well-graded sands and gravels, and gravel-sand-silt mixtures ranging in thickness from approximately 200 to 500 feet below ground surface with an average thickness of 175 feet. These outwash deposits constitute the primary groundwater aquifer at the site. Minor seams of silt and clay were also encountered, but there was no indication of a consistent confining layer beneath the site.

3. Hydrology

Groundwater occurs in the study area at depths ranging from 5 to 20 feet below ground surface ranging from 752 to 756 feet (MSL). The elevation of the bottom of the waste mass is estimated to range from 755 to 760 feet (MSL) The outwash aquifer is unconfined below the Himco Site, and the silt and clay confining layer is absent. Groundwater flow is generally to the south, southeast, toward the St. Joseph River, a groundwater discharge area. Local groundwater flow appears to be consistent with regional conditions. The average groundwater flow velocity is estimated to be 121 feet/year. Three specific groundwater characteristics which may be important factors in contaminant migration include low horizontal gradient, low upward vertical gradients, and fluctuations in water table levels. Groundwater fluctuations at the Himco Site may be important because water table elevations are relatively near the landfill waste. Upward fluctuations may result in a more direct contact between groundwater and the waste mass thereby providing a more rapid mechanism by which contaminants from the landfill enter the groundwater system.

4. Contamination

a. Source

The source of contamination from the Himco Site is the landfilled waste. A proper cap was never installed, thereby allowing precipitation to infiltrate through hazardous constituents in the landfill and leak into the groundwater. In addition, there is a possibility of air emissions of VOCs and SVOCs through the existing cover. Test pit excavations in the landfill revealed the presence of a non-homogenous waste matrix. In addition, leachate was observed in the majority of trenches excavated at elevations above the water table. Leachate collected at the southwest corner of the landfill was red and brown and separated into two phases. The floating phase of the leachate contained approximately 48 percent toluene by weight. This location has been referred to as the "hot spot" in the landfill. An emergency removal was conducted in May 1992 to remove this hot spot. Figure 2 shows the location of the hot spot.

Generally, three fill layers were observed consistently in the landfill. The top layer can be characterized as a silty, sand cover, soil fill which ranged in thickness from a thin veneer to several feet. Underlying the sand cover, and in some cases at ground surface, calcium sulfate was found. It varied in thickness from a few inches to as much as nine feet at the southeastern, central, and southern areas of the landfill. Overall, the thickness was found to be less than 2 feet in 62.5 percent of test pit excavations. The areal extent of the calcium layer is shown in Figure 3. Beneath the calcium sulfate layer, an estimated 15- to 20-foot thick waste layer was found. This waste layer was found to include paper, plastic rubber, wood, glass, metal (including drums), as well as small amounts of hospital wastes.

Non-native soil mixed with construction debris was observed in test pits outside the landfill area along the south central and southwest edge of the landfill. This section is referred to as the construction debris area and is identified in Figure 3. No calcium sulfate was found in this area. SVOC contamination was found to be most prominent in surface soil samples collected here.

b. Groundwater

Two rounds of groundwater sampling during the RI revealed

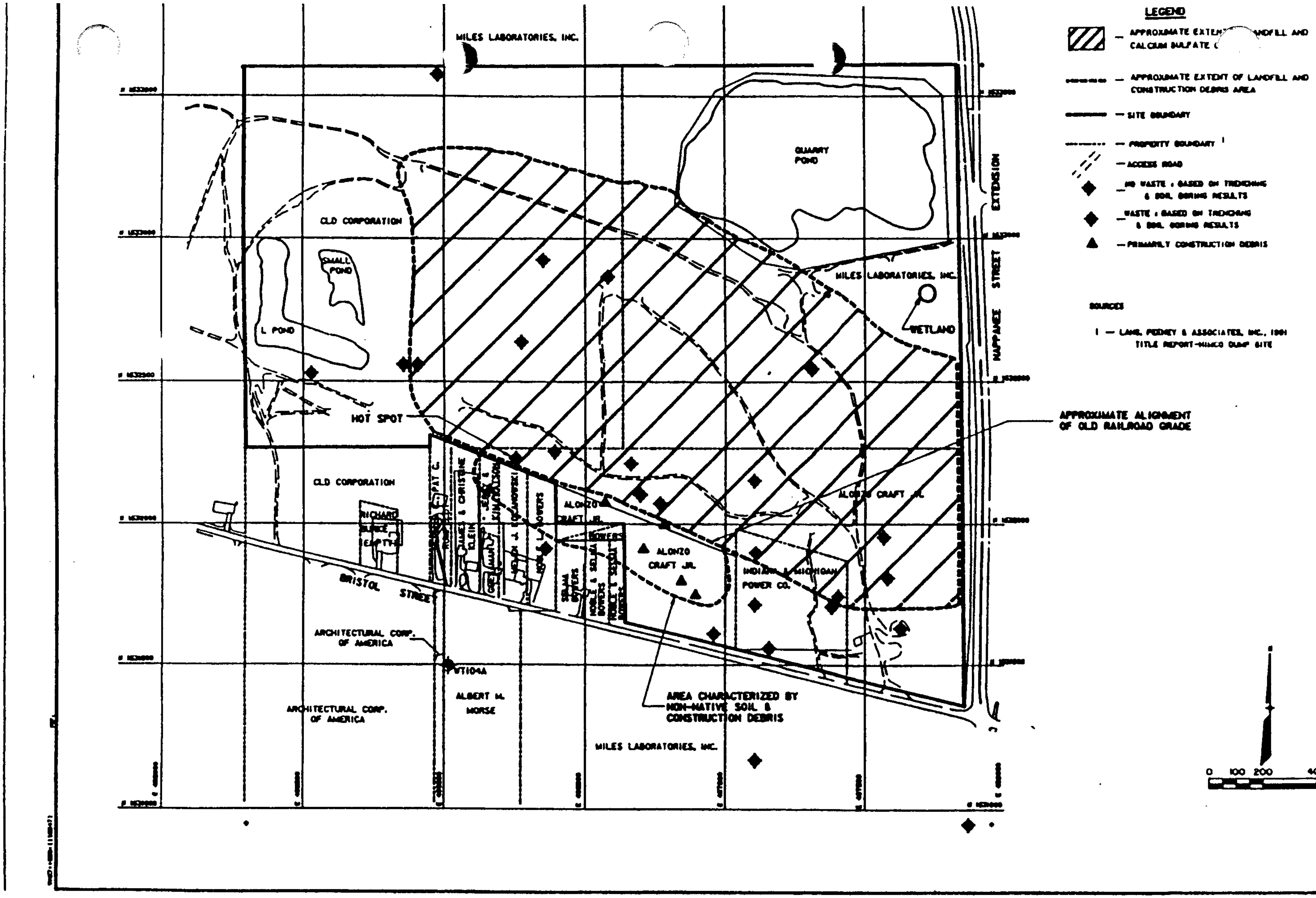


FIGURE 3
APPROXIMATE LANDFILL BOUNDARY

limited groundwater contamination outside the boundaries of the waste. In general, trace amounts of VOCs and SVOCs were detected in groundwater samples. During RI Phase I sampling, trichloroethene was detected above MCLs in two wells, J1 and J2, which are located approximately 2,000 feet off-site and side gradient to the Himco site.

In the wells south of the landfill, MCLs for nine chemicals were exceeded at least once; however, it has not yet been established that the contamination results from the site. Most were inorganics (antimony, arsenic, beryllium, chromium, lead, nickel and sulfate), although low levels of VOCs were also detected. Beryllium contamination was found at similar detection levels in background wells. Arsenic and antimony were detected at significantly higher concentrations than in background wells. Except for beryllium, nickel and sulfate, all the chemicals which exceeded MCLs south of the landfill also exceeded MCLs in the trench leachate samples.

c. Leachate

Leachate was sampled from four test pits and analyzed for VOCs, SVOCs, pesticides/PCBs, metals/cyanide, and water quality. Figure 4 shows trench locations. Leachate from test pit TL5 separated into two phases of almost pure product and leachate. Analysis of the pure product phase showed approximately 50% toluene.

Concentrations of VOC and inorganic contaminants detected in leachate were typically orders of magnitude higher than groundwater concentrations. The highest concentrations of VOCs and SVOCs were detected in leachate from TL5. Traces of pesticides were detected in leachate TL1 and TL2.

There are no adequate natural or man-made barriers to isolate leachate from groundwater at this site. Leachate may potentially enter the groundwater due to the gravity flow. Contaminants entering the groundwater may potentially migrate off-site through the local and regional groundwater flow.

d. Soil

Contaminants were detected primarily in surface soils. Arsenic and beryllium were detected in surface soil samples located across the western half of the site, around the quarry pond, and in the south-central area, which is characterized by non-native soil and construction debris. The highest concentrations of arsenic were detected in soil samples from the south central area. Beryllium was detected at several locations at relatively consistent

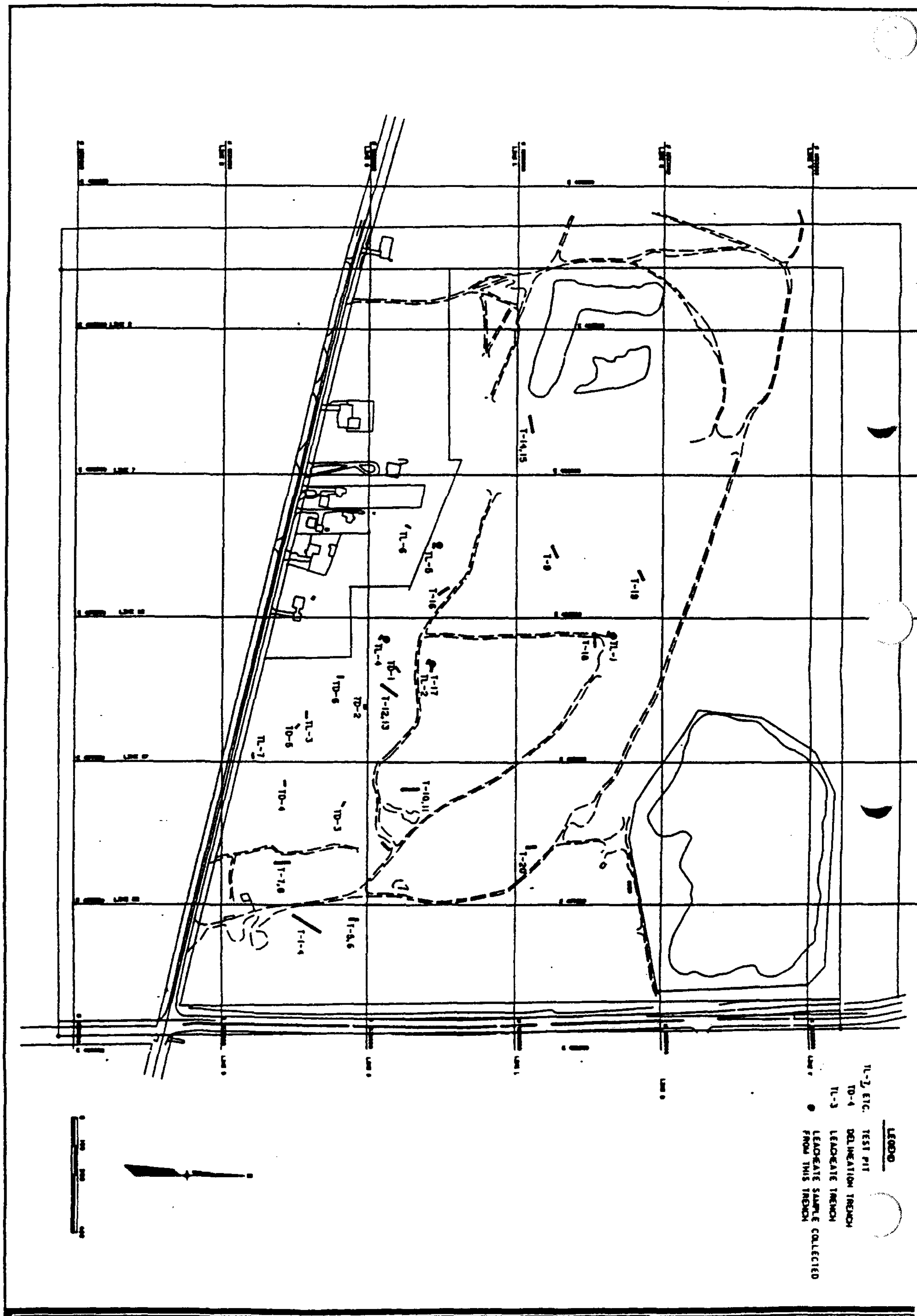


FIGURE 4
TRENCH LOCATIONS

Donohue Engineers

concentrations.

VOCs were detected in many places across the site at low concentrations. SVOC soil contamination was found to be most prominent in samples collected in the south-central area which is characterized by non-native soil and construction debris. Pesticides were detected in two soil samples collected from this area. A summary of inorganic, VOC, and SVOC concentration ranges may be found in tables 1, 2, and 3 respectively. Figure 5 presents the locations where SVOCs were detected.

F. SUMMARY OF SITE RISKS

The analytical data collected during the RI and the baseline risk assessment indicated the presence of contaminants in various media at levels that may present a risk to human health. Pursuant to the NCP, a baseline risk assessment was performed based on data from the RI. The baseline risk assessment assumes no corrective action will take place and that no site-use restrictions or institutional controls such as fencing, groundwater use restrictions or construction restrictions will be imposed. The risk assessment then determines actual or potential carcinogenic risks or toxic effects the chemical contaminants at the site pose under either current or future land use assumptions.

1. Contaminant Identification

The media of concern for human exposures for current and future scenarios were identified primarily as groundwater and soils which have been contaminated from the landfilled wastes. During the RI several chemicals in different media were detected and a list of "chemicals of potential concern" was developed using the following criteria:

- Any chemical detected at least once in any on-site soil, groundwater, leachate, surface water or sediment sample was considered to be a possible chemical of concern.
- Several chemicals known to be essential for human nutrition were eliminated. These chemicals were present at levels that are considered non-toxic.
- Samples considered to be background were not used in the selection process, nor were the data from residential wells just south of the landfill due to the uncertainty regarding the integrity of those residential wells.

TABLE 1

SUMMARY OF INORGANIC ANALYTES DETECTED IN SURFACE SOIL
HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA
1992

Analyte	Background (mg/kg) B-02	B-04	B-06	95% * Lower/Upper Levels (Background)	Range of Concentrations Detected (mg/kg)
Aluminum	5,100(J)	5,720	3,920(J)	3,655/6,172	9.7(B)-6,780(J)
Antimony	ND	ND	ND	4.3/4.3	3.1(BJ)-46.8
Arsenic	1.5(B)	2.0(B)	1.1(BJ)	0.91/2.2	0.47(B)-5.8
Barium	62	61.1	35.5(BJ)	32.2/73.6	1.3(BJ)-101
Beryllium	.69(BJ)	.27(BJ)	ND	ND/0.77	0.20(BJ)-0.91(BJ)
Cadmium	ND	ND	ND	.06/.06	1.1(B)
Calcium	386(B)	498(B)	736(B)	294/786	360(B)-321,000(J)
Chromium	6.5(J)	7.1	4.5	4.2/7.9	1.1(B)-13.2
Cobalt	3.7(B)	3.3(B)	ND	0.49/4.7	1.5(B)-5.3(B)
Copper	4.7(B)	4.3(BJ)	3.8(BJ)	3.7/4.9	1.3(B)-216
Iron	6,370	6,740	4,690(J)	4,429/7,437	9.8(BJ)-10,100
Lead	7.8	7.0	81(J)	ND/90	0.5(BJ)-245(J)
Magnesium	762(B)	976(B)	440(BJ)	355/1,097	14.6(BJ)-14,000
Manganese	402	421	70(J)	2,519/569	1.3(BJ)-561(J)
Mercury	ND	ND	ND	.06/.06	0.13(J)-0.54(J)
Nickel	6.5(B)	7.5(B)	ND	.29/9.8	2.4(B)-12.0
Potassium	252(B)	213(B)	115(B)	96.2/291	86.6(B)-678(B)
Selenium	0.25(BJ)	ND	ND	0.23/0.44	0.27(BJ)-1.4(J)
Silver	ND	ND	ND	0.50/0.50	0.49(B)-2.8(BJ)
Sodium	ND	ND	ND	5.0/5.0	20.8(B)-90.6(B)
Thallium	ND	ND	ND	0.24/0.24	ND
Vanadium	11.8	11.6	10.4(BJ)	10.2/12.3	1.6(BJ)-19.1
Zinc	20.5	22.4	8.4	6.7/27.6	1.7(B)-229
Cyanide	ND	ND	ND	0.60/0.60	1.3-24.3

Qualifiers

ND - Below detection limit
B - Analyte found in the associated blank as well as in the sample
J - Indicates an estimated value
* - Half of the detection limits were used for non-detects

A/R/HIMCO/AJ2

TABLE 2

SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN SURFACE SOILS
HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA
1992

Compound	Background * (ug/kg)	Range of Concentrations Detected (ug/kg)
Methylene Chloride	ND	3(J)-16
Acetone	ND	8(BJ)-140
Carbon Disulfide	ND	0.8(J)
1,1-Dichloroethene	ND	5(J)
2-Butanone	ND	2(J)-8
Tetrachloroethene	ND	6(J)
Trichloroethene	ND	0.9(J)-4(J)
Toluene	8	2(J)-31
Ethyl Benzene	ND	0.7(J)-2(J)
Styrene	ND	0.8(J)
Xylenes (total)	ND	0.7(J)-6
1,2-Dichloroethene (total)	ND	ND
1,1,1-Trichloroethane	ND	ND

Qualifiers

ND - Below detection limit
J - Indicates an estimated value
* - Samples from borings B-02, B-04, and B-06 (0' to 2')

A/R/HIMCO/AJ2

TABLE 3

SUMMARY OF SEMI-VOLATILE COMPOUNDS DETECTED IN SURFACE SOILS
HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA
1992

Compound	Background * (ug/kg)	Range of Concentrations Detected Above Background (ug/kg)
Naphthalene	ND	18(J)
2-Methylnaphthalene	ND	18(J)
Dimethylphthalate	ND	41(J)
1,4-Dichlorobenzene	80	120(J)-210(J)
Diethylphthalate	80(J)	ND
Benzoic Acid	ND	75(J)
Acenaphthene	ND	59(J)-310(J)
Dibenzofuran	ND	23(J)
Fluorene	ND	43(J)-120(J)
Phenanthrene	ND	42(J)-1,500
Anthracene	ND	82(J)-240(J)
Di-n-butylphthalate	100(J)	92(J)-490(J)
Fluoranthene	ND	17(J)-2,800
Pyrene	ND	34(J)-2,000(J)
Butylbenzylpthalate	ND	300(J)
Benzo(a)anthracene	ND	25(J)-1,300
Chrysene	ND	37(J)-1,600
bis(2-Ethylhexyl)phthalate	93(J)-570(J)	18(J)-7,800(J)
Benzo(b)fluoranthene	ND	67(J)-3,200
Benzo(k)fluoranthene	ND	82(J)-1,700
Benzo(a)pyrene	ND	430(J)-2,200
Indeno(1,2,3-cd)pyrene	ND	230(J)-3,700
Dibenzo(a,h)anthracene	ND	94(J)-550(J)
Benzo(g,h,i)perylene	ND	250(J)-3,500
Carbazole	ND	36(J)
Total Carcinogenic PAHs	ND	138(J)-14,250(J)
Total Non-carcinogenic PAHs	ND	51(J)-8,340(J)

Qualifiers

ND Below detection limit
J - Indicates an estimated value
* - Samples from borings B-02, B-04, and B-06 (0' to 2')

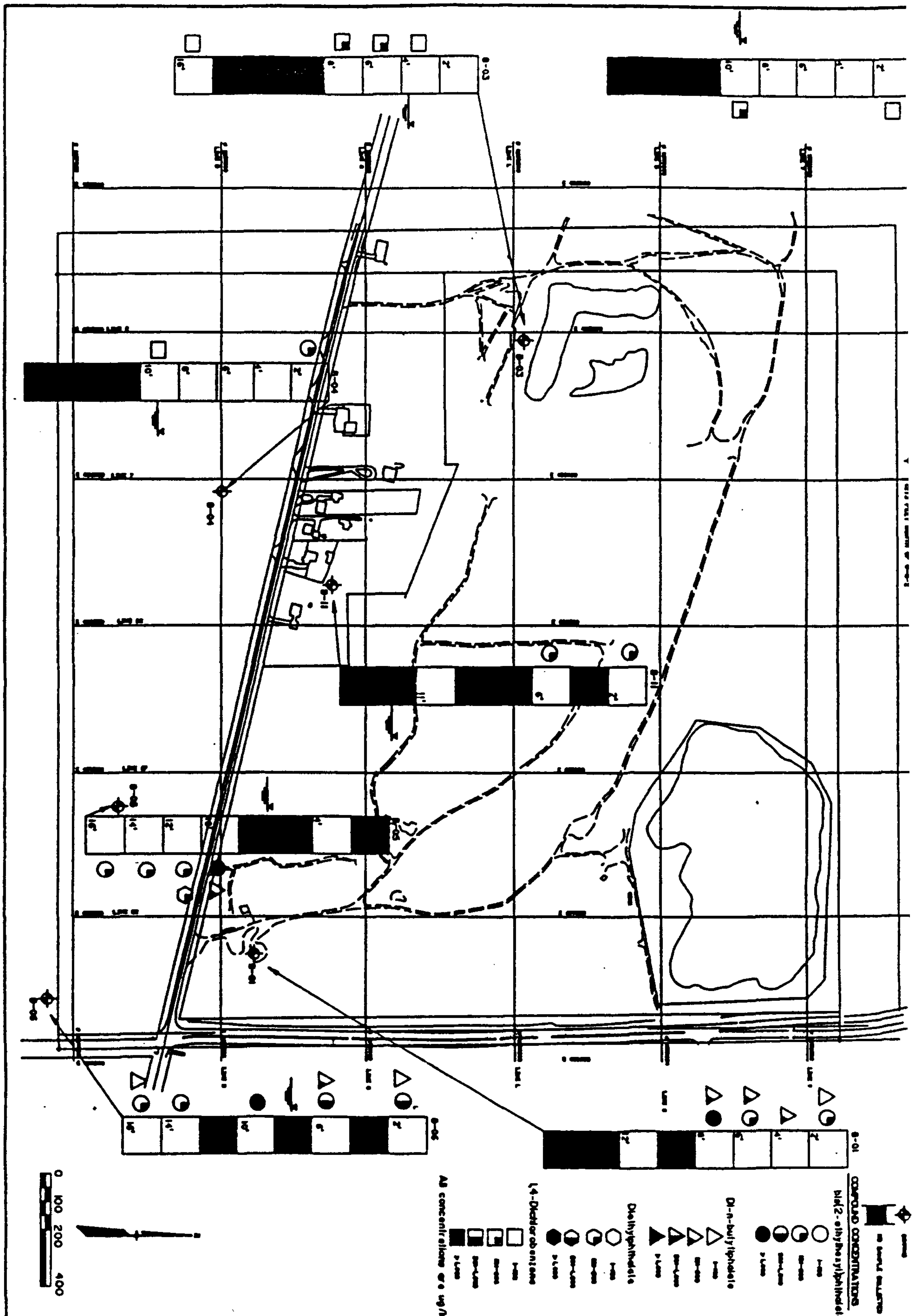


FIGURE 5
SEMI-VOLATILE COMPOUNDS DETECTED IN SUBSURFACE SOILS
MIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA

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The chemicals of potential concern are listed in Table 4.

2. Human Health Effects

The health effects for the contaminants of concern may be found in Volume 5 of the RI.

3. Exposure Assessment

The baseline risk assessment examined potential pathways of concern to human health under both current and future land-use scenarios for the landfill property and surrounding area.

The following pathways were selected for detailed evaluation under current-use conditions:

- Inhalation of airborne particulates or VOCs released from the site (residents northeast of the site and dirt-bike riders on-site),

- Incidental ingestion of surface soil by trespassers while dirt-bike riding,

- Ingestion of surface water and sediment while wading or fishing,

- Dermal contact with surface water while wading.

The following pathways were selected for detailed evaluation under future-use conditions and include future residential, commercial, agricultural, or recreational uses. Future residents and workers were evaluated both on the landfill area and south of the landfill. Agricultural workers were evaluated on the landfill area only. The pathways are:

- Inhalation of airborne particulates or VOCs released from the site, including evaluation to a downwind resident as part of an agricultural future use.

- Incidental ingestion of surface soil,

- Ingestion of groundwater,

- Inhalation of volatiles released during indoor uses of groundwater,

- Dermal exposures to groundwater.

TABLE 4 CHEMICALS OF POTENTIAL CONCERN - HIMCO DUMP SITE

INORGANICS:

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Iron
Lead
Mercury
Nickel
Silver
Thallium
Vanadium
Cyanide

ORGANICS:

VOLATILES

1,1-Dichloroethane
1,1-Dichloroethene
1,1,1-Trichloroethane
1,2-Dichloroethene
2-Butanone
2-Hexanone
4-methyl-2-pentanone
Acetone
Benzene
Bromodichloromethane
Carbon disulfide
Chlorobenzene
Chloroethane
Chloroform
Ethylbenzene
Methylene chloride
Styrene
Tetrachloroethene
Toluene
Trichloroethene
Vinyl chloride
Xylenes

SEMIVOLATILES

1,4-Dichlorobenzene
2,4-Dimethylphenol
2-Methylnaphthalene
2-Methylphenol
4-Methylphenol
Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzoic Acid
Benzyl alcohol
bis(2-Ethylhexyl) phthalate
Butylbenzylphthalate
Chrysene
Carbazole
Dibenzofuran
Dibenz(a,h)anthracene
Diethylphthalate
Dimethylphthalate
Di-n-butylphthalate
Di-n-octylphthalate
Fluoranthene
Fluorene
Indeno(1,2,3-cd) pyrene
Naphthalene
Phenanthrene
Phenol
Pyrene

PESTICIDES/PCB's

4,4'-DDT
4-4'-DDE
Aldrin
alpha-BHC
alpha-Chlordane
beta-BHC
Dieldrin
Endosulfan II
gamma-Chlordane
Heptachlor
Polychlorinated biphenyl - Aroclor 1248

NON-CLP CHEMICALS:

Bromide, dissolved
Chloride
Nitrogen, ammonia
Nitrogen, nitrate & nitrite
Phosphorus
Sulfate

4. Risk Characterization

For each potential receptor, site-specific contaminants from all relevant routes of exposure were evaluated. Both non-carcinogenic health effects and carcinogenic risks were estimated.

a. Non-Carcinogenic Health Risks

Reference doses (RfDs) have been developed by U.S. EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting non-carcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of average daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse non-carcinogenic effects to occur.

The Hazard Index (HI), an expression of non-carcinogenic toxic effects, measures whether a person is being exposed to adverse levels of non-carcinogens. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across multiple media. The HI for non-carcinogenic health risks is the sum of all contaminants for a given scenario. Any Hazard Index value greater than 1.0 suggests that a non-carcinogen potentially presents an unacceptable health risk.

b. Carcinogenic Health Risks

Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays. The excess lifetime cancer risks are the sum of all excess cancer lifetime risks for all contaminants for a given scenario.

Excess Lifetime Cancer Risks are determined by multiplying the intake level by the cancer potency factor for each contaminant of concern and summing across all relevant chemicals and pathways. These risks are probabilities that are generally expressed in scientific notation (e.g. $1 X 10^{-6}$). An excess lifetime cancer risk of 1×10^{-6} indicates that a person's chance of contracting cancer as a result of site related exposure averaged over a 70-year lifetime may be increased by as much as 1 in one million. The U.S.EPA generally attempts to reduce the excess lifetime cancer risk at Superfund sites to a range of 1×10^{-4} to 1×10^{-6} (1 in 10,000 to 1 in one million), with an emphasis on the lower end (1×10^{-6}) of the scale. Tables 5 and 6 summarize the excess lifetime cancer risks and HI values estimated for the current land-use scenario, respectively. Tables 7 and 8 summarize the excess lifetime cancer risks and HI values estimated for the future land-use scenario respectively, at the Himco Site.

c. Characterization of Lead

The U.S. EPA evaluates noncancer risks from lead by a different method than those described above. The Agency believes that an acceptable approach is to estimate the likely effects of lead exposure on the concentration of lead in the blood. The Uptake/Biokinetic model was used to predict blood lead levels for the scenarios evaluated at this site. The U.S. EPA has identified 10 ug/L of lead in the blood as the level of concern for health effects in children. Of all the scenarios evaluated, there is a cause for concern if the groundwater beneath the landfill is used as a drinking water source.

5. Risk Summary

A major threat is the migration of the plume off-site at detectable levels of concern. Some contamination above MCLs has been found in wells south and southeast of the landfill that either was not found or exceeded levels in background wells and that may be attributable to site contamination.

The potential excess lifetime cancer risk posed by the Site exceeds the acceptable risk range of $1 X 10^{-4}$ to $1 X 10^{-6}$ principally from the use of contaminated groundwater under the future use scenario. Risks from ingestion, dermal contact and inhalation of volatiles from this groundwater present carcinogenic risks in the range of $1 X 10^{-1}$. South of the landfill, downgradient, the estimated excess cancer

TABLE 5 SUMMARY OF ESTIMATED CARCINOGENIC RISK - CURRENT POPULATIONS

Exposed Population	Exposure Point	Exposure Medium	Exposure Route	Total Excess Cancer Risk
Dirt-bike rider	Site	Soil	Ingestion	2E-06
		Air	Inhalation - Particulates	2E-06
			Inhalation - VOCs	2E-08
			Total	4E-06
Wader	Quarry Pit	Surface Water	Ingestion	1E-08
			Dermal	4E-09
		Sediment	Ingestion	3E-08
			Total	4E-08
Wader	Ponds	Surface Water	Ingestion	1E-08
			Dermal	3E-09
		Sediment	Ingestion	8E-09
			Total	2E-08
Downwind off-site residents:				
Adult	Home	Air	Inhalation - Particulates	1E-07
			- Volatiles	7E-08
			Total	2E-07
Child	Home	Air	Inhalation - Particulates	1E-06
			- Volatiles	2E-06
			Total	3E-06

TABLE 6 SUMMARY OF ESTIMATED CARCINOGENIC RISK - HYPOTHETICAL FUTURE RESIDENTIAL POPULATIONS

Exposed Population	Exposure Point	Exposure Medium	Exposure Route	Total Excess Cancer Risk
Resident On Landfill:				
Adult	Home	Groundwater	Ingestion	1E-01
			Inhalation - VOCs	4E-04
			Dermal	1E-01
		Soil	Ingestion	5E-05
		Air	Inhalation - Particulates	1E-07
			Inhalation - VOCs	8E-07
			Total	2E-01
Child	Home	Groundwater	Ingestion	6E-02
			Inhalation - VOCs	2E-04
			Dermal	6E-01
		Soil	Ingestion	4E-05
		Air	Inhalation - Particulates	1E-07
			Inhalation - VOCs	2E-06
			Total	7E-01
Resident South of Landfill - Shallow Groundwater:				
Adult	Home	Groundwater	Ingestion	4E-03
			Inhalation - VOCs	6E-05
			Dermal	1E-04
		Soil	Ingestion	6E-04
			Total	5E-03
Child	Home	Groundwater	Ingestion	2E-03
			Inhalation - VOCs	4E-05
			Dermal	1E-03
		Soil	Ingestion	4E-04
			Total	3E-03
Resident South of Landfill - Deep Groundwater:				
Adult	Home	Groundwater	Ingestion	4E-03
			Inhalation - VOCs	6E-05
			Dermal	1E-04
		Soil	Ingestion	6E-04
			Total	5E-03
Child	Home	Groundwater	Ingestion	2E-03
			Inhalation - VOCs	3E-05
			Dermal	1E-03
		Soil	Ingestion	4E-04
			Total	3E-03

TABLE 7 SUMMARY OF NONCARCINOGENIC RISK - CURRENT POPULATIONS

Exposed Population	Exposure Point	Exposure Medium	Exposure Route	Hazard Index Subchronic	Hazard Index Chronic
Dirt-bike Rider	Site	Soil	Ingestion	--[(a)]	7E-03
		Air	Inhalation - Particulates	--	2E-01
			Inhalation - VOCs	--	3E-05
			Total	--	2E-01
Wader	Quarry Pit	Surface Water	Ingestion	5E-04	--
			Dermal	4E-04	--
		Sediment	Ingestion	1E-03	--
			Total	2E-03	--
Wader	Ponds	Surface Water	Ingestion	3E-04	--
			Dermal	5E-04	--
		Sediment	Ingestion	2E-04	--
			Total	1E-03	--
Downwind off-site resident:					
Adult	Home	Air	Inhalation - Particulates	--	1E-01
			- Volatiles	--	1E-03
			Total	--	1E-01
Child	Home	Air	Inhalation - Particulates	6E-02	--
			- Volatiles	1E-02	--
			Total	7E-02	--

(a) Exposure not evaluated for this population.

TABLE 8 SUMMARY OF NONCARCINOGENIC RISK – HYPOTHETICAL FUTURE RESIDENTIAL POPULATIONS

Exposed Population	Exposure Point	Exposure Medium	Exposure Route	Hazard Index[a]
Resident On Landfill:				
Adult	Home	Groundwater	Ingestion	5E+02
			Inhalation – VOCs	2E+00
			Dermal	2E+01
		Soil	Ingestion	2E-01
		Air	Inhalation – Particulates	1E-02
			Inhalation – VOCs	1E-03
			Total	5E+02
Child	Home	Groundwater	Ingestion	9E+02
			Inhalation – VOCs	4E+00
			Dermal	1E+02
		Soil	Ingestion	8E-01
		Air	Inhalation – Particulates	7E-03
			Inhalation – VOCs	1E-02
			Total	1E+03
Resident South of Landfill – Shallow Groundwater:				
Adult	Home	Groundwater	Ingestion	9E+00
			Inhalation – VOCs	2E-01
			Dermal	8E-01
		Soil	Ingestion	1E-01
			Total	1E+01
Child	Home	Groundwater	Ingestion	2E+01
			Inhalation – VOCs	2E-01
			Dermal	3E+00
		Soil	Ingestion	5E-01
			Total	2E+01
Resident South of Landfill – Deep Groundwater:				
Adult	Home	Groundwater	Ingestion	4E+00
			Inhalation – VOCs	2E-01
			Dermal	9E-01
		Soil	Ingestion	1E-01
			Total	5E+00
Child	Home	Groundwater	Ingestion	9E+00
			Inhalation – VOCs	2E-01
			Dermal	4E+00
		Soil	Ingestion	5E-01
			Total	1E+01

(a) Hazard index is subchronic for child populations and chronic for all others.

risks to a future resident are approximately 5×10^{-3}. The hazard index for humans interacting with the Site exceed the acceptable hazard index of 1.0. For future use of the groundwater under the landfill, the hazard index values are approximately 500 to 1,000.

Some of these risks are caused in some part by chemicals which could be present at levels close to levels found in background wells (that is, wells located upgradient of the site). These chemicals include arsenic, antimony and beryllium. The sampling results do not clearly indicate whether or not the site is actually contributing more of these chemicals to the groundwater; however, even if the risks due to these possible background chemicals were not included in the risk estimates, there still are risks from other chemicals that indicate the groundwater beneath the landfill should not be used as a drinking water source.

In addition to groundwater, there is an estimated excess cancer risk of 4 to 6×10^{-4} to a future resident living south of the landfill where Polynuclear Aromatic Hydrocarbons (PAHs) were detected in the soil.

6. Environmental Risks

An ecological risk assessment was conducted to characterize the biological resources at the site and adjacent habitats, and identify actual and potential impacts to these resources associated with releases of hazardous substances from the site.

Contaminants present in the soil where the prairie communities are located are unlikely to pose adverse impacts to resident species of plants and animals. The greatest hazard to resident organisms occurs in the south/southeast area of the site where contamination is higher and more varied. This area is highly disturbed and unlikely to support ecologically significant populations. Small mammals are likely to inhabit this area and may be exposed to contaminants. Other areas of the site are unlikely to pose a significant threat of adverse effects to exposed organisms. The potential exposures of ecological concern are summarized in Table 9.

G. RATIONALE FOR FURTHER ACTION

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementation of the response action selected by this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment. Therefore, based on the findings in the RI report and the

TABLE 9

EXPOSURE SCENARIOS FOR ECOLOGICAL POPULATIONS
HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA
1992

Exposure Point	Exposed Population	Exposure Activity	Relative Potential Magnitude of Exposure
L-Pond, Small Pond and Quarry Pond	Benthic invertebrates	Direct uptake, feeding	High
	Fish	Direct uptake, feeding	High
	Phytoplankton	Direct uptake	High
	Zooplankton	Direct uptake, feeding	High
	Resident shorebirds	Ingestion of water, soil, and sediment; feeding	Low to Moderate
	Migratory waterfowl	Ingestion of water, soil, and sediment; feeding	Very Low
	Terrestrial wildlife (including avian)	Ingestion of water, soil, and sediment; feeding	Low to Moderate
	Aquatic macrophytes	Direct uptake	High
	Aquatic organisms exposed to runoff from watershed	Direct uptake, feeding	Low to Moderate
Terrestrial Locations	Terrestrial plants	Growth in contaminated soil; uptake	High
	Terrestrial invertebrates and wildlife (including burrowing animals, soil invertebrates, avian predators, e.g., eagles)	Ingestion of contaminated water and soil; direct contact with contaminated soil; consumption of contaminated plants and animals	Very Low to High
Wetland	Wetland vegetation exposed to runoff and contaminated soil	Direct uptake	Moderate to High

discussion above, a Feasibility Study (FS) was performed to focus on the development of alternatives to address the threats at the Site. The FS report documents the evaluation of the magnitude of site risks, site-specific applicable or relevant and appropriate requirements, and the requirements of CERCLA and the NCP in the derivation of remedial alternatives for the Site.

H. DESCRIPTION OF ALTERNATIVES

Although the NCP reaffirms U.S. EPA's preference for permanent solutions to Superfund site problems through the use of treatment technologies, the preamble to the NCP contemplates that many remedial alternatives may be impractical for certain sites due to severe implementability problems or prohibitive costs (e.g., treatment of the entire contents of a large landfill). Since the Himco Site contains a 58 acre landfill, U.S. EPA believes that treatment of the landfill contents is impracticable because of severe implementability problems, danger to workers and nearby residents, and prohibitive costs; therefore, the FS was directed at the evaluation of containment rather than treatment of the source material. Source control alternatives range from no action to capping with leachate collection and treatment.

Because the target risk level of one in 10,000 (1×10^{-4} for carcinogenic risk and HI of 1 for noncarcinogenic risk) is currently exceeded in background groundwater samples, the NCP target risk levels cannot be specified for the groundwater downgradient of the Himco Site. Additionally, RI data do not conclusively indicate that groundwater outside the boundaries of the contaminated areas is currently being impacted by the site contaminants; therefore, at this time a groundwater remedy and cleanup standards have not been developed for this Site.

A groundwater monitoring program is a component of each alternative except the no action alternative. Groundwater monitoring has been incorporated in the alternatives to evaluate the effectiveness of the remedy. The FS has established contamination levels for contaminants of concern which would trigger an additional groundwater investigation if the remedy fails and those levels are reached.

All caps would be designed to minimize any adverse impact to the wetland, delineated during the RI.

Alternative 1 - No Action

The NCP requires that a No Action alternative be evaluated at every site to serve as a baseline for comparison against the other cleanup alternatives. It assumes that no corrective action will be taken at the site. It has no cost or operation and maintenance associated with it. It does not provide any long-term effectiveness and permanence; nor does it provide a reduction of toxicity, mobility, or volume through treatment.

Alternative 2 - Containment by Means of a Solid Waste Cap; Active Landfill Gas Collection and Treatment; Groundwater Monitoring; and Institutional Controls

Alternative 2 includes a single barrier, solid waste cap to contain the landfill waste mass and the contaminated surface soil in the construction debris area and in an area immediately south of the landfill, and an active landfill gas collection and treatment system with vapor phase carbon adsorption. A groundwater monitoring program will be implemented and institutional controls will be placed on the site by means of fencing, access restrictions, deed restrictions, and groundwater use restrictions. The primary components of this alternative include the following:

<u>Cap Construction</u>

The entire landfill waste mass and the contaminated surface soil in the construction debris area and in the area immediately south of the landfill will be capped. Site preparation and layout will be completed to re-route surface water drainage away from the capped area. The cap will consist of an 18-inch vegetated soil layer, a 6-inch sand drainage layer, and a 2-foot thick, low permeability clay layer. The vegetative soil layer will be seeded, if possible, with the current on-site plant species to preserve the uniqueness of the prairie assemblage at this site. An additional layer of soil (buffer) of approximately 2.15 feet will be laid over the existing landfill to attain a 4 percent grade required by the State of Indiana and to facilitate drainage.

<u>Groundwater Monitoring</u>

A groundwater monitoring program will be implemented to monitor groundwater quality downgradient of the site and to evaluate if the remedy is effective in protecting the site groundwater from adverse impacts by site contaminants.

<u>Landfill Gas</u>

An active landfill gas collection system will be located in a grid network throughout the landfill. The off-gas from the landfill will be treated by means of a vapor phase carbon system if landfill gas characterization studies indicate VOC emissions exceed ARARs. The spent carbon would be tested by TCLP to determine if it is hazardous by characteristic, and then managed accordingly. If any methane gas is generated, creating explosive conditions, an enclosed ground flare system will be implemented to burn it.

Institutional Controls

Institutional controls will be implemented, which include installation of a fence around the landfill and contaminated soils covered by the cap; and deed restrictions limiting the site's future land use as well as restrictions on groundwater use in the site vicinity.

The estimated costs for this alternative are:

Capital Cost: $7,539,000
Annual O&M Cost: $210,000
Total Present Worth: $10,429,000

Alternative 3 - Containment by Means of a Single Barrier, Solid Waste Cap; Active Landfill Gas Collection and Treatment; Leachate Collection and Off-Site TSDF Disposal; Groundwater Monitoring; and Institutional Controls

Alternative 3 is the same as Alternative 2 with the addition of a leachate collection system and off-site disposal.

Leachate Collection System

A leachate collection system, consisting of vertical wells placed in the landfill to extract leachate generated in the landfill, will be constructed. Six hundred eighty wells, spaced 56 feet apart will be installed in the landfill. The collected leachate will be transported by means of an interconnecting piping system to a central collection point, then transported for treatment and disposal to a licensed, treatment, storage and disposal (TSDF) facility. Compliance with Indiana State Codes regulating disposal of wastewater would be required.

Capital Cost: $13,628,000
Annual O&M Cost: $982,000
Total Present Worth: $27,140,000

Alternative 4 - Containment by Means of a Composite Barrier, Solid Waste Cap; Active Collection and Treatment of Landfill Gas; Groundwater Monitoring; and Institutional Controls

This alternative is similar to alternative 2, except the cap is a composite barrier, solid waste cap. The cap structure is the same as alternative 2 except that upon the 2-foot clay layer and under the 6-inch sand drainage layer, there will be a 40 millimeter, high density polyethylene (HDPE) flexible membrane liner. The composite cap provides an added level of landfill gas containment and greater control of infiltration into the waste mass, over the single barrier cap. The composite cap greatly reduces the need for a leachate collection system.

Capital Cost: $8,931,000
Annual O&M Cost: $210,000
Total Present Worth: $11,821,000

I. Summary of Comparative Analysis of Alternatives

In accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), the relative performance of each alternative is evaluated using the nine criteria, Title 40 of the Code Federal Regulations (40 CFR) Section 300.430(e) (9) (iii), as a basis for comparison. An alternative providing the "best balance" of trade-offs with respect to the nine criteria is determined from this evaluation.

The following two threshold criteria, overall protection of human health and the environment, and compliance with Applicable or Relevant and Appropriate Requirements (ARARs) are criteria that must be met in order for an alternative to be selected.

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether a remedy eliminates, reduces, or controls threats to human health and to the environment.

The major exposure pathways of concern at the Site are from ingestion, inhalation, and direct contact with the landfill waste mass and contaminated soils in the construction debris area. The continued release of leachate into the groundwater aquifer and outside the landfill boundaries also presents a risk to human health and the environment. Environmental risk may result from the release of landfill fugitive dust into the air.

Alternative 1 does not satisfy the requirement for overall protection of human health and the environment. Alternatives 2 and 3 provide protection to human health and the environment by reducing risk by containing the landfill waste mass, and the contaminated surface soil in the construction debris area and in an area immediately south of the landfill, with a single barrier, solid waste cap and by collecting and treating the landfill gas. With these alternatives, human risk associated with exposure to the wastes in the landfill and the contaminated surface soil in the construction debris area and in an area immediately south of the landfill is theoretically eliminated. Additionally, risk associated with release of the leachate into the groundwater or outside the landfill boundaries is reduced.

Alternative 3 provides further reduction of risk with the extraction and off-site treatment and disposal of leachate from the landfill. This reduces the potential for release of contaminants into groundwater or other media outside the landfill boundaries. Alternative 4 provides a greater reduction in risk than Alternatives 2 and 3 because the composite cap provides an added level of landfill gas containment and greater control of infiltration into the waste mass, over the single barrier cap, thereby minimizing the potential release of leachate into the groundwater and other media outside of the landfill boundaries (the composite cap greatly reduces the need for a leachate collection system).

2. Compliance with Applicable or Relevant and Appropriate Requirements

This criterion evaluates whether an alternative meets ARARs set forth in federal, or more stringent state, environmental standards pertaining to the site or proposed actions.

Because the No Action alternative does not involve conducting any remedial action at the site, no ARARs analysis is necessary for Alternative 1. Alternatives 2, 3, and 4 are expected to be in compliance with ARARs.

3. Long-Term Effectiveness and Permanence

This criterion refers to the ability of an alternative to maintain reliable protection of human health and the environment over time. The primary focus of this evaluation is the extent and effectiveness of controls that may be required to manage the risk posed by treatment residuals and/or untreated waste.

Alternative 1, the No Action alternative, provides no long-term effectiveness and would result in continuation of the elevated risk levels that currently exist at the Himco site.

Alternatives 2 and 3 provide long-term effectiveness and permanence by containing the landfill waste mass, and the contaminated surface soil in the construction debris area and in an area immediately south of the landfill, with a single barrier, solid waste cap. The cap will reduce ingestion, inhalation, and direct contact with contaminated materials and will reduce infiltration of precipitation into the waste mass which reduces leachate generation, thereby reducing the potential for off-site groundwater contamination. Alternative 3 further reduces risk with the leachate collection system; however, because groundwater is hydraulically connected with the landfill waste, there is uncertainty as to the effectiveness of collecting the leachate. Alternatives 2 and 3 also provide long-term effectiveness and permanence by implementing institutional controls to maintain the cap's integrity and restrict groundwater use in the site vicinity.

Alternative 4, like Alternatives 2 and 3, provides long-term effectiveness and permanence through containment and reduction of infiltration and by implementing institutional controls to maintain the cap's integrity, as well as to restrict groundwater use in the site vicinity. The composite barrier solid waste cap in Alternative 4 further reduces infiltration, which reduces the generation of leachate, thereby providing a greater reduction in risk and in the potential for off-site groundwater contamination.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion evaluates treatment technology performance in the reduction of chemical toxicity, mobility, or volume. This criterion addresses the statutory preference for selecting remedial actions which include, as a principal element, treatment that permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants.

Alternative 1 provides no reduction in toxicity, mobility, or volume. Alternatives 2 through 4 provide a slight reduction in toxicity or volume in VOCs from landfill gas collection. Alternative 3 provides an added marginal reduction in toxicity and volume through the leachate collection. Alternatives 2, 3, and 4 provide reduction in mobility by reducing leachate generation in the landfill. The liner system in Alternative 4 provides a greater reduction in the leachate generation rate than that in Alternatives 2 and 3, further reducing mobility of contaminants in the landfill.

5. Short-Term Effectiveness

Short-term effectiveness considers the time to reach cleanup objectives and the risks an alternative may pose to site workers, the community, and the environment during remedy implementation until cleanup goals are achieved.

Potential risks from Alternatives 2, 3 and 4 to the community during implementation are from exposure to airborne dust and organic vapors from the waste mass and leachate. Workers employed in the construction of the gas collection system, the leachate collection system and the cap may be exposed to the waste mass and leachate material. All the alternatives, except Alternative 1, include measures to minimize the short-term impacts during construction, such as dust control and the use of safe work practices.

6. Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative, and the availability of various services and materials required for its implementation.

All the alternatives are implementable and can be readily constructed with technology and materials presently available. The composite barrier cap in Alternative 4 will take a little more time for installation than the single barrier cap in Alternatives 2 and 3. Operation of Alternative 3 will be more difficult because it includes a leachate collection and storage system and requires periodic disposal of leachate at an off-site TSDF.

7. Cost

This criterion compares the capital, O&M, and present worth costs of implementing the alternatives at the Site. Table 10 shows the Cost Summary.

8. State Acceptance

The State of Indiana is in agreement with the selection of Alternative 4 for remediation of the Himco Dump Site and has provided U.S. EPA with a letter of concurrence.

9. Community Acceptance

Community concerns have been thoroughly reviewed and are addressed in the attached Responsiveness Summary.

J. The Selected Remedy

Based upon considerations of the requirements of CERCLA, the NCP and balancing of the nine criteria, the U.S. EPA has determined that Alternative 4, a Composite Barrier, Solid Waste Cap; Active Collection and Treatment of Landfill Gas; Groundwater Monitoring; and Institutional Controls, is the most appropriate remedy for the Himco Dump Site.

The components of the selected remedy are as follows:

- A composite barrier, solid waste cap with an area equal to approximately 58 acres,consisting of: an 18-inch vegetated soil layer; a 6-inch sand drainage layer; a 40 millimeter, high density polyethylene (HDPE) flexible membrane liner; a 2-foot thick, low permeability clay layer and an additional layer of soil (buffer) of approximately 2.15 feet laid over the existing landfill to attain the State of Indiana

TABLE 10

COST SUMMARY
Himco Dump Superfund Site
Elkhart, Indiana

Alternatives	Capital Cost	Annual O&M Cost	Total Present Worth Cost*
1. No Action	$0	$0	$0
2. Single Barrier Cap, Gas Collection & Treatment, Groundwater Monitoring, & Institutional Control	$7,539,000	$210,000	$10,429,000
3. Single Barrier Cap, Gas Collection & Treatment, Leachate Collection System, Groundwater Monitoring, & Institutional Control	$13,628,000	$982,000	$27,140,000
4. Composite Barrier Cap, Gas Collection & Treatment, Groundwater Monitoring, & Institutional Control	$8,931,000	$210,000	$11,821,000

* Present worth cost based on interest(i)=6% and 30 years for O&M (see Tables 4-1 through 4-4).

required 4 percent grade and to facilitate drainage.

- Institutional controls including fencing, deed restrictions limiting the land use of the site, and groundwater use restrictions.

- An active landfill gas collection system including a vapor phase carbon system to treat the off-gas from the landfill.

  An enclosed ground flare system will be implemented if landfill gas characterization studies indicate VOC emissions exceed ARARs.

- A groundwater monitoring program designed to detect changes in concentration of hazardous constituents in the groundwater and to detect the presence and concentration of site related contamination in drinking water wells near the Site.

  The groundwater monitoring program shall continue for 30 years. Samples shall be analyzed for target compound list (TCL), VOCs and target analyte list (TAL) metals.

- Mitigative measures will be taken during remedy construction activities to minimize adverse impacts to the wetland.

K. Statutory Determinations

U.S. EPA's primary responsibility at Superfund Sites is to undertake remedial actions that protect human health and the environment. Section 121 of CERCLA has established several other statutory requirements and preferences. These include the requirement that the selected remedy, when completed, must comply with all applicable, relevant and appropriate requirements ("ARARs") imposed by Federal and State environmental laws, unless the invocation of a waiver is justified. The selected remedy must also provide overall effectiveness appropriate to its costs, and use permanent solutions and alternative treatment technologies, or resource recovery technologies, to the maximum extent practicable. Finally, the statute establishes a preference for remedies which employ treatment that significantly reduces the toxicity, mobility or volume of contaminants.

The selected remedy will satisfy the statutory requirements established in Section 121 of CERCLA, as amended by SARA, to protect human health and the environment, will comply with ARARs (or provide grounds for invoking a waiver), will provide overall effectiveness appropriate to its costs, and will use permanent solutions and alternate treatment technologies to the maximum extent practicable. Treatment is not a component of the selected remedy because an attempt to treat the hazardous substances present at the site in soils and leachate would not provide a sufficiently significant additional decrease in risk presented by the site to justify the increased cost of attempting such treatment.

1. Protection of Human Health and the Environment

Implementation of the selected remedy will protect human health and the environment by reducing the risk of exposure to hazardous substances present in surface soils and leachate at the site. An adequate final cover for the site will reduce the risk of exposure to hazardous substances present in soil at the site, and will also reduce the rate of infiltration by which precipitation passes through the contaminated soil and maintain that reduction over time. By reducing the rate of infiltration, the final cover will also reduce the rate of leachate generation in the landfill; therefore, the final cover will also reduce the risk that hazardous substances, pollutants, and contaminants present in the leachate will migrate and contaminate the aquifer. Groundwater monitoring will be required to provide early warning against the risk that the hazardous substances present in the leachate may migrate and contaminate the aquifer. Institutional controls will be imposed to restrict uses of the site to prevent exposure to hazardous substances and contaminants in the soil and the leachate at the site. No unacceptable short-term risks will be caused by implementation of the remedy. The community and site workers may be exposed to dust and noise nuisances during construction of the final cover. Mitigative measures will be taken during remedy construction activities to minimize impacts of construction upon the surrounding community and environs. Ambient air monitoring will be conducted and appropriate safety measures will be taken if contaminants are emitted.

2. Compliance with ARARs

The selected remedy will comply with all identified applicable or relevant and appropriate federal requirements, and with those state requirements which are more stringent, unless a waiver is invoked pursuant to Section 121(d)(4)(B) of CERCLA. The ARARs for the selected remedy are listed below:

A. Federal ARARs

<u>Chemical-Specific Requirements</u>

Chemical-specific ARARs regulate the release to the environment of specific substances having certain chemical characteristics. Chemical-specific ARARs typically determine the standard for clean-up at a site.

Resource Conservation and Recovery Act (RCRA)

As the hazardous wastes at this site were placed prior to the effective date of the regulations, the chemical-specific requirements of RCRA are not applicable. As the leachate from the waste mass is highly contaminated by hazardous substances similar to RCRA hazardous substances, the chemical-specific requirements of RCRA are relevant and appropriate. 40 CFR 141 requires that ground water used as drinking water meet Maximum Contaminant Levels ("MCLs") for contaminants of concern.

Safe Drinking Water Act

40 CFR 141

Federal Drinking Water Standards promulgated under the Safe Drinking Water Act ("SDWA") include both Maximum Contaminant Levels ("MCLs") and, to a certain extent, non-zero Maximum Contaminant Level Goals ("MCLGs"), that are applicable to municipal drinking water supplies servicing 25 or more people. At the Himco Dump Site, MCLs and MCLGs are not applicable, but are relevant and appropriate, because the unconfined aquifer below the site is a Class II aquifer which has been used by residences bordering the site, is presently being used by residences in the area surrounding the site and could potentially be used in the future as a drinking water source.

The National Contingency Plan ("NCP") at 40 CFR 300.430 (e) (2) (i) (B) provides that MCLGs established under the Safe Drinking Water Act that are set at levels above zero, shall be attained by remedial actions for ground waters that are current or potential sources of drinking water. The point of compliance for federal drinking water standards is at the boundary of the solidified/stabilized waste, because this is the point where humans could potentially be exposed to contaminated groundwater. Because this site will have a final clay cover, the point of compliance will be at the boundary of the final cover. Ground water monitoring wells will be installed at the point of compliance to ensure that any release of contaminated leachate from the site which could adversely affect the aquifer is detected at the earliest possible stage. Existing ground water wells in the aquifer will also be monitored, and additional wells may be drilled and monitored, if necessary.

Location-Specific Requirements

Location-specific ARARs are those requirements that derive from the physical nature of the site's location and features of the local geology and hydrogeology such as wetlands and floodplains.

Resource Conservation and Recovery Act ("RCRA")

Executive Orders 11988 11990, 40 CFR Part 6, Appendix A

Since the RI has identified wetlands adjacent to the site, the action must be carried out in such a way as to prohibit discharge of dredged or fill material into wetlands without a permit, avoid adverse effects, minimize potential harm, and preserve and enhance wetlands, to the extent possible. Executive Order 11990 (Protection of Wetlands) is an applicable requirement. Executive Order 11990 requires that actions taken at the Site be conducted in a manner minimizing the potential for destruction, loss, or degradation of wetlands.

Wetlands will be monitored and evaluated. ARARs for wetlands will be met through the continued evaluation of the wetlands, and if necessary, implementation of a plan to limit degradation, or restore the wetlands.

Action-Specific Requirements

Resource Conservation and Recovery Act ("RCRA")

Landfills

40 CFR 264.310

This regulation requires the installation of a final cover to provide long-term minimization of infiltration. This regulation also requires 30-year post-closure care and ground-water monitoring. The Regional Administrator may revise the length of post-closure care period pursuant to 40 CFR 264.117(a)(2)(i) if he finds that a reduced period is sufficient to protect human health and the environment; or extend the length of the post-closure care period pursuant to 40 CFR 264.117(a)(2)(ii) if he finds that the extended period is necessary to protect human health and the environment.

Although the hazardous waste in this landfill was placed before the effective date of the requirements, and therefore, this regulation is not applicable; it is nevertheless clearly appropriate in light of the wastes similar or identical in chemical structure to RCRA hazardous wastes that pose the threats which this action will be designed to address. This regulation establishes standards for the final cover and requires compliance with the regulations which govern post closure care set forth at 40 CFR 264.117-120.

Post Closure Care

40 CFR 264.117(a)(1)

While the requirements for post closure care set forth at 40 CFR 262.117 through 264.120 are not applicable to this site, the presence of hazardous substances similar to RCRA hazardous wastes in the dump make several of these regulations relevant and appropriate. This includes the requirement for maintenance and monitoring of the waste containment systems for thirty years.

40 CFR 264.117(c)

The remedy selected for this site requires U.S. EPA to restrict post-closure use of this property as necessary to prevent damage to the cover. Post closure use of the property must never be allowed to disturb the integrity of the cover, the liner, or any other component of the containment system, or the function of the facility's monitoring systems, unless the Regional Administrator finds that the disturbance is necessary to the proposed use of the property and will not increase the potential hazard to human health and the environment, or the disturbance is necessary to reduce a threat to human health and the environment

40 CFR 264.228(b)
40 CFR 264.310(b)

It will be necessary to prevent run-on and run-off from damaging the cover.

<u>Closure with Waste in Place</u>

40 CFR 264.228(a)(2)
40 CFR 264.258(b)

These regulations require the elimination of free liquids by removal or solidification, and the stabilization of remaining waste and waste residue to support cover. Because the RCRA hazardous waste in this landfill was placed before the effective date of the regulations, they are not applicable, but may be considered relevant and appropriate.

<u>Clean Air Act</u>

40 CFR 50 and 52

The Clean Air Act and the regulations cited above require that select types and quantities of air emissions be in compliance with regional air pollution control programs, approved State Implementation Plans ("SIP"s) and other appropriate federal air criteria. The selected remedy involves installation of a gas collection system which may release contaminants or particulates into the air. Emission and technology requirements promulgated under this act are relevant and appropriate, including provisions of the State of Indiana's SIP.

B. State ARARs as Identified by the State of Indiana

- Wetlands Protection through the State of Indiana Water Quality Surveillance Standards Branch and the Indiana DNR Division of Water Requirements

- Ambient Air Quality Standards (Title 326 IAC Article 1-3)

- Indiana VOC Emission Standards (Title 326 IAC Article 2-1 and 8-1-6)

- Indiana fugitive dust control (Title 326 IAC Article 6-4)

- Indiana Solid Waste Landfill Cover Standards (Title 329 IAC Articles 2-4, 2-14, 2-15 and 3.1-9

- Indiana Solid and Hazardous Waste Management (Title 329 IAC Article 2-21)

The remedy will attain the state standards listed above to the extent that such standards are applicable, or relevant and appropriate, promulgated standards more stringent than the comparable federal standard.

3. Cost Effectiveness

Cost effectiveness compares the effectiveness of an alternative in proportion to its cost of providing environmental benefits. Table 11 lists the costs associated with the implementation of the selected remedy.

TABLE 11

Total estimated costs for the selected remedy at the Himco Dump Site:

Alternative	Total Capital Cost	Total O&M, 30 Yr.	Total Present Worth
4	$8,931,000	$2,890,000	$11,821,000

The selected remedy for this site is cost effective because it provides the greatest overall effectiveness proportionate to its costs when compared to the other alternatives evaluated, the net present worth being $11,821,000. The estimated cost of the selected remedy is comparable with Alternatives 2 and 3, and assures a high degree of certainty that the remedy will be effective in the long-term due to the significant reduction of the mobility of the contaminants achieved through containment of the source material and the decrease in leachate generation. The addition of a leachate collection system would provide only a limited additional reduction of risk to public health and the environment. The uncertain effectiveness of such a system, which would be very difficult to implement, does not justify the additional cost for this component.

4. Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a cost-effective manner at this site. Of those alternatives that are protective of human health and the environment and that comply with ARARs, U.S. EPA has determined that the selected remedy provides the best balance in terms of long-term effectiveness and permanence, reduction of toxicity, mobility, or volume of contaminants, short term effectiveness, implementability, and cost, taking into consideration State and community acceptance.

The installation and maintenance of a final cover for the landfill, ground water monitoring, and restriction of site access through installation of a fence and institutional controls, will provide the most permanent solution practical, proportionate to the cost.

5. Preference for Treatment as a Principal Element

Based on current information, U.S. EPA and the State of Indiana believe that the selected remedy is protective of human health and the environment and utilizes permanent solutions and alternative treatment technologies to the maximum extent possible. The remedy, however, does not satisfy the statutory preference for treatment of the hazardous substances present at the site as a principal element because such treatment was not found to be practical or cost effective.

HIMCO DUMP

RESPONSIVENESS SUMMARY

This Responsiveness Summary has been prepared to meet the requirements of Sections 113(k)(2)(iv) and 117(b) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (CERCLA), which requires the United States Environmental Protection Agency (U.S. EPA) to respond "...to each of the significant comments, criticisms, and new data submitted in written or oral presentations" on a proposed plan for a remedial action. The Responsiveness Summary addresses concerns expressed by the public, potentially responsible parties (PRPs), and governmental bodies in written and oral comments received by U.S. EPA and the State of Indiana regarding the proposed remedy for the Himco Dump Site.

Overview

The Himco Dump site is a closed landfill located at County Road 10 and the Nappanee Street Extension in Cleveland Township, adjacent to the City of Elkhart, Elkhart County, Indiana. The site is located approximately two miles north of the St. Joseph River which runs east-west through the City of Elkhart. The site covers approximately 100 acres and is bounded on the north by a tree line and a gravel pit pond; on the west by two ponds (an L shaped pond called the "L" pond, and the small pond); on the south by County Road 10 and private residences; and on the east by Nappanee Street Extension.

There is an abandoned gravel pit operation in the northeast corner of the site. An old truck scale and concrete structures are also present in this area. The gravel pit is filled with water which is approximately 30 feet deep. Two smaller and shallower ponds, the L pond and the small pond, are on the west side of the site.

The Himco site was privately operated by Himco Waste Away Service, Inc., and was in operation between 1960 and September 1976. In 1971, the Indiana State Board of Health (ISBH) first identified the Himco site as an open dump. In early 1974, residents along County Road 10 south of the Himco site complained to ISBH about color, taste, and odor problems with their shallow wells. Analyses of six shallow wells along County Road 10, ranging in depth from 20 to 30 feet, showed high levels of manganese. Mr. Chuck Himes, the principal landfill operator, replaced these wells with deeper wells ranging in depth from 152 to 172 feet below ground surface. By mid-1990, the wells showed high concentrations of sodium which posed a chronic health threat to the residents. By November 1990, municipal water service was provided to those residents whose wells were affected and was financed by Miles Laboratories, Inc. and Himco Waste Service, Inc. In 1976, the landfill was closed.

In June 1988, the Himco site was proposed for the National Priorities List (NPL) and in February 1990, was officially placed on the NPL and designated a Superfund site. The site RI/FS was begun in 1989 and completed in 1992.

Public Comment Period

A public comment period on the FS and Proposed Plan for this Site was initiated on September 30, 1992 and was originally scheduled to run for 30 days. However, the Agency received requests from Potentially Responsible Parties to extend the comment period, so in response to these requests, the comment period was extended through November 30, 1992. A public meeting was held on October 6, 1992 at the Municipal Building in Elkhart, Indiana. At this meeting, representatives from U.S. EPA and IDEM presented the Proposed Plan, answered questions, and accepted comments from the public. Approximately 60 people were in attendance. Comments received during the comment period are included in this Responsiveness Summary.

The RI Report, the FS and the Proposed Plan for the Site were made available to the public on September 30, 1992. These documents are available in both the administrative record and information repositories maintained at U.S. EPA offices in Chicago, Illinois, the Elkhart Public Library and the Pierre Moran Branch Library in Elkhart, Indiana.

Summary of Comments

The public comments regarding the Himco Dump Site are organized into the following two categories:

- Summary of comments from local residents regarding the FS and the Proposed Plan;

- Summary of comments from the PRPs concerning the FS and the Proposed Plan.

Many of the comments below have been paraphrased in order to effectively summarize them in this document. The reader is referred to the Administrative Record for this Site, located at U.S. EPA offices in Chicago, Illinois and the Elkhart Public and Pierre Moran Branch Libraries in Elkhart, Indiana. The Administrative Record also contains a copy of the public meeting transcript.

Comments from Residents of the Community Affected by the Landfill

Comment: The majority of comments from the affected community thank U.S. EPA for conducting the study. They want the site cleaned without any more delays. Some of the comments support our remedy; however, most of the comments reflect the community's desire to excavate the landfill and avoid a "cover-up" remedy. In addition, all but one comment from the community want the leachate pumped and treated.

Response: It would be impractical to excavate the entire landfill. The material would need to be treated in some way which would be extremely expensive. After treatment, the residual material would then need to be landfilled.

The leachate collection system was not recommended because, due to the fact that the groundwater is hydraulically connected with the landfill waste, and it is unlikely that the leachate wells would effectively collect the leachate. In addition, 680 extraction wells would need operation and maintenance and the system would require perpetual pumping, treatment and disposal, at substantial cost.

Comment: The proposed cap will not stop vertical infiltration. What will happen when rain and snow melt is dumped on uncovered areas?

Response: The cap will greatly reduce vertical infiltration. The composite liner provides an added layer of protection, further minimizing infiltration into the landfill. The new cap will prevent rain and snow melt from coming in contact with any contaminated material and therefore, will not carry contamination to uncovered areas.

Comment: The groundwater is being contaminated by the landfill.

Response: The RI shows the site is not currently impacting the groundwater near the landfill. To insure the quality of the groundwater, a groundwater monitoring plan will be developed during the design. As part of this plan, the Agency will set trigger levels for contaminants of concern (contaminants identified in the RI). If the monitoring results show that these levels are being exceeded, a ground water study will be initiated to further evaluate the site conditions and identify the potential remedy if required. The Maximum Contaminant Levels (MCLs) established for drinking water are proposed as the trigger levels for most of the contaminants of concern. Levels for the remaining contaminants of concern (antimony, lead, vanadium, and methylene chloride) are calculated based on concentrations found in background wells, using a formula developed for monitoring at RCRA facilities (Statistical Analysis of Ground Water Monitoring

Data at RCRA Facilities, Interim Final Guidance, April 1989). A more extensive discussion of the method of determining the trigger levels may be found in Appendix A of the FS Report.

Comment: Deed restrictions are worthless. Deed restrictions can be eliminated any time in the future if the present owners, heirs, or powers of attorney so elect to do.

Response:

Institutional controls (such as deed restrictions) can be used (and typically are used) in conjunction with engineering controls as part of a remedial action in order to ensure protection of human health and the environment. Although it is true that at this site institutional controls, including deed restrictions to limit land and groundwater use, cannot by themselves be relied upon to protect public health, they do impose a legal obligation upon the owner of the property or future purchasers to abide by the restrictions. If the Agency negotiates a Consent Decree with Defendants which own Superfund Site property and deed restrictions are required by that Consent Decree, the deed restrictions become legally enforcable. Therefore the Agency believes that requiring deed restrictions, to prevent future development of the Site or any consumptive use of the groundwater, will enhance the protectiveness of the remedy. In the event that deed restrictions are not implemented, and another institutional control is necessary to ensure protectiveness, EPA will consider such measures at that time.

Comment: Almost every comment from the affected community was adamant in having the Potentially Responsibility Parties (PRPs) pay for the clean-up.

Response: U.S. EPA has an enforcement first policy and will negotiate with the PRPs at this site to conduct the clean-up. However, if no good faith offer to conduct and/or finance the remedy is received from the PRPs, U.S. EPA will consider other options.

Comments from the Potentially Responsibility Parties

INTRODUCTORY STATEMENT:

Comments were received from several PRPs and/or their contractors. Three provided extensive comments, while the others provided letters supporting the comments of others. All PRP commentors recommended a no action alternative. To support this recommendation, they offered a number of comments in regard to the preparation of the risk assessment for the Himco site. These comments challenged the Agency's approach, exposure assumptions and methods by which the risk assessment process was implemented. The Agency believes that the risk assessment process was conducted in accordance with accepted guidance, applying site-specific factors and utilizing reasonable yet conservative assumptions where required. In nearly every instance, the alternative approach or assumption as suggested by the commentors would not have affected the choice of the proposed remedy.

Because of the voluminous, redundant nature of the comments received from the three PRPs, they will be addressed in summary fashion, grouping comments under major headings. Comments will be numbered sequentially under each heading for ease of reference. See the Administrative Record for the specific comments.

Comments on Assessment of Future Use of the Site

Comment F1: One commentor stated that "The State of Indiana and U.S. EPA uniformly agree that the property should not and will not be used for the construction of any buildings." The commentor provided two letters from the Chief of the Facilities Inspection Section of the Indiana Board of Health to the Elkhart County Health Department recommending against construction of residences on the site. (Miles)

Response F1: The letters provided only advise against construction of buildings on the site; they do not prohibit construction on the landfill. In addition, the letters are focussed on construction on the landfill itself. They do not address the parts of the Site beyond the bounds of the landfilled area.

Comment F2: The same commentor also said installing groundwater wells at the landfill is prohibited by Indiana law. (Miles)

Response F2: The commentor is referring to Indiana Administrative Code, 310 IAC Section 16-3-2, which says that a "well shall be located as follows: ...(2) as far as practicable from any: ...(B) known contamination source. This does not outright forbid a well being installed on the site. The risk assessment process looked at future risk scenarios in terms of what is reasonably possible for the entire site if no remediation took place, not what could potentially be prevented through institutional controls (a remedial measure) on the landfill.

Comment F3: One commentor stated that U.S. EPA guidance suggests that risk assessments should include a qualitative statement of the likelihood of the future land use occurring and quoted the Risk Assessment as saying that 'this scenario' (residential or commercial development) "may not be technically and/or financially reasonable". (Geraghty & Miller)

Response F3: The Risk Assessment does state that, "...composition of the natural soils in combination with the shallow water table and fill material would make construction on the site difficult and potentially costly." However, it goes on to say that construction "along the perimeter of the site (not on the landfill) would be more feasible."

Comment F4: Commentors stated that U.S. EPA incorrectly assumed that the HIMCO property will be used in the future for residential, industrial, and agricultural purposes and that construction will occur on the landfill. One commentor indicated that the NCP requires U.S. EPA to evaluate the likelihood that future populations will be exposed to contaminants on the subject property. (Miles, Geraghty & Miller, Himco Waste-Away Service/ Mittelhauser)

Response F4: The Agency does not agree that there is "no doubt" that the site will never be used for any residential, agricultural or industrial purposes. In fact, inquiries as to the feasibility of site development for residential and light industry were explored as recently as 1984.

The role of the baseline risk assessment is to develop scenarios for relevant, possible land uses in the absence of institutional controls. Residential, agricultural, and industrial uses are all possible although their likelihood differs. The possibility of each of these is based on factors including surrounding land use in the area, historical uses of the land (portions of the site were once agricultural) and developmental feasibility. Additionally, the baseline risk assessment provides qualitative information on the likelihood of a future land use actually occurring. For instance, at this site the risk assessment clearly stated that there is low probability of a future residential or commercial land use (at least on the landfilled area), there is some likelihood of the site returning to agricultural uses, and there is some probability that the site could be developed for recreation. This type of information provides the EPA risk manager the basis for selecting the extent of remediation which will be required.

It is important to distinguish between the "site" and the "landfill." There is nothing at this time that renders it unlikely that homes may be built on the site south of the landfill. Homes have been built along County Road 10 south of the landfill. The contaminated area between County Road 10 and the landfill is obviously a place where people might be likely to build homes if it were not for the risk posed by soil contamination and contaminated leachate. Institutional controls such as zoning prohibitions, fencing, posting of signs and other restrictions simply cannot ensure that the site will never be used in the future. Since there is some likelihood of some kind of future use (people have even been known to place homes on landfills), it is appropriate for the risk assessment to evaluate such exposures and for risk management decisions to take this information into account in making remedial decisions.

Comments on the ground water pathway

Comment G1: One commentor quoted the RI/FS that revealed "very little or no ground water contamination outside the boundary of the landfill" and that "ground water has not been impacted to a level of health and environmental concern by the site contaminants," and concurred with these conclusions. (Geraghty & Miller)

Response G1: The U.S. EPA acknowledges the commentor's concurrence with our conclusions.

Comment G2: The groundwater pathway should be eliminated because the ground water is not currently used, is not potable and is not likely to be used in the future. (Miles, Geraghty & Miller, Himco Waste-Away Service/Mittelhauser)

Response G2: Although there are no current users adjacent to the landfill, there are drinking water wells in the nearby surrounding area. As recently as a year ago a resident just southwest of the landfill drilled a drinking water well. It is not certain that the groundwater will never be used as a drinking water source; therefore, it is appropriate to evaluate such a possibility. The aquifer in question is a Class II aquifer, and so, the Agency is obligated to protect it. The contaminants of concern (listed in Table 4 of the ROD) identified in the groundwater below the landfill clearly present an unacceptable risk and cannot be allowed to migrate. The construction of a cap over the landfill will help prevent the generation of additional leachate and the contamination from migrating in the future, and the ground water monitoring will detect if this remedy does not provide the containment/control expected. If the contamination had been shown to have migrated already, the Agency would be obligated to restore this Class II aquifer.

Other Comments Regarding the Risk Assessment

Comment R1: The trespasser scenario is incorrect for the following reasons: 1) the activity is illegal, 2) the emission rate did not account for days of precipitation, and 3) two different numbers were used for silt content. (Miles)

Response R1: 1) The legality of a human activity is not relevant in evaluating exposure. There is sufficient evidence that dirt bike riding occurs at the site to warrant its inclusion. Trails are evident and the activity was observed during field work at the site. Exposure thus occurs whether the rider has gained legal access to the site or not.

2) The emission rate is calculated only during a bike riding event. It was assumed that bike riding would only occur on days when it was not raining. (If a person rode in the rain, the emissions would probably not occur, therefore there would be no exposure.) For this reason the term in Cowherd's equation accounting for days of precipitation would be equal to one. Thus the emission rate calculated in the risk assessment would not change with the inclusion of this parameter.

3) Both the dirt bike and tilling models require a silt content term in their respective equations. These activities are assumed to occur in different areas of the site. During the remedial investigation, samples from these respective areas were analyzed for grain size. An estimate of silt content is also made with these analyses. These results were used in the modeling. It is not surprising, it is even expected, that silt content varies from location to location across different areas of the site.

Comment R2: The box model was inappropriately applied for the following reasons: 1) use of one-half the height of the box, 2) the calculation of X, 3) the average wind speed measurement, 4) the lack of a dispersion model for the downwind receptor, 5) the unrealistic assumption that an adult will dirt bike ride on the landfill for 30 years. (Miles)

Response R2: 1). One-half the height of the box was used in the calculations for the following reasons. First it was assumed that the upwind edge of the box was located at the upwind edge of the source area and the downwind edge of the box occurred at the downwind edge of the source area. A plume of suspended particles was assumed to rise from the upwind edge of the box and reach the mixing height calculated at the downwind edge of the source. Since a hypothetical resident or dirt bike rider could live or ride anywhere within this box, the average height of the box (H/2) was used to calculate exposure to that individual. This approach may tend to overestimate exposure for a resident (or rider) living (or riding) near the downwind edge of the box and underestimate exposure for a resident (or rider) at the upwind edge of the box.

2) It is true that the assumption that the box is square is not stated in the risk assessment. This assumption was indeed made; the calculation of X is correct.

3) The wind speed from the nearest available weather station was used in place of on-site meteorological data, which were not available. It is likely that the measurement was made at a height of 10 meters. It is also assumed that obstructions near the surface would slow the windspeed, resulting in a lower annual

average wind speed at the height used in the box model. Use of a higher windspeed than actually occurs at the height that was evaluated is likely to have underestimated exposure. The magnitude of this underestimate cannot be reliably estimated.

4) It is agreed that the box model is not reliable for estimating exposures at significant distances downwind from a source. However, at this site, the nearest off-site current residents are located just east of the edge of the landfill. Therefore, they were assumed to be located effectively at the downwind edge of the box. While some uncertainty was introduced by assuming that the nearest current resident was located at the downwind edge of the box, it was judged acceptable for risk assessment purposes. It should be remembered that this is not a sophisticated model--its intent is for screening purposes. The model predicted very low emissions which represent risks well within an acceptable range. Risks contributed by this pathway were not significant relative to overall site risks and did not form the basis for the proposed remedy. Further refinement of the air pathway is not warranted.

5) The Agency disagrees that the adult dirt bike rider is unrealistic. Adulthood does not necessary bring the cessation of this type of activity. Again, the pathways involving air exposures were not significant in their contribution to total site risk. Therefore the use of exposure factors that the commentor feels are overly conservative did not influence the selection of a remedy.

One commentor offered a number of comments about other exposure analyses, as follows. (Miles)

<u>Comment R3a:</u> The soil concentrations are biased high and misapplied since sampling was not random.

<u>Response R3a:</u> The sampling design utilized at this site was a stratified systematic design. The design was a consistent pattern apportioned across the site areas. Two exposure areas were defined and assumed: on the landfill and south of the landfill. This method, while not random, is nevertheless unbiased. It is appropriate for use in defining representative concentration values over the two exposure areas. If the sampling were biased, averaging samples over an exposure area would not have been appropriate.

<u>Comment R3b:</u> Episodic air emissions should not be added to steady-state long-term atmospheric exposures in the UBK model for lead.

<u>Response R3b:</u> It is true that the UBK model does not routinely handle episodic air emissions. The UBK model does allow for both

an ambient air default or other inputs based on site measurements or predictions from air modeling. At this site, the additional emissions predicted from the tilling or dirt bike riding activities are several orders of magnitude lower than the ambient default value in the model. Therefore, addition of the episodic emissions had no effect on the model outcome.

Comment R3c: Assumed parameters for exposure factors are arbitrary. For example, the skin surface area for children (commentor did not identify any other examples.)

Response R3c: It is true that the use of an assumed skin surface area of 10,000 cm^2 is slightly higher than the value now recommended by EPA in its Dermal Guidance document. That value is 8,000 cm^2, which is the 95th percentile of the average of age classes 1-6. Use of this number would slightly lower the risk estimates for children via dermal exposures to groundwater. (For example, the excess cancer risk estimates for the hypothetical future child resident on the landfill would drop from 7E-01 to 6E-01.) This is not a significant difference.

The revision of the Exposure Factors Handbook, referred to by the commentor, is still a preliminary draft (July 1991). However, the values suggested in that draft correspond to the values suggested in the released Dermal Guidance (as described above).

Comment R3d: Two HIF terms in the evaluation of the agricultural worker were reversed.

Response R3d: The Agency agrees these terms were inadvertently reversed when risk calculations were performed. This error has been corrected and the risk results are summarized below:

Route	Cancer Risk (original)	Cancer Risk (revised)	HI (original)	HI (revised)
Ingestion of Groundwater	3E-03	3E-03	1E+01	1E+01
Ingestion of Soil	4E-06	4E-05	2E-02	2E-02
Inhalation-Particulates	5E-05	2E-06	4E+00	2E-01
Inhalation-Volatiles	2E-09	3E-08	4E-06	7E-05
Total (all pathways)	3E-03	3E-03	1E+01	1E+01

As seen above, total risks to the population would not change although the individual pathway risks are different. Again, the inhalation pathway contributes little to overall risk and those results did not form the basis for the selection of a remedy.

Comment R3e: The exposure assessment for showering arbitrarily assumes inhalation intake is twice oral intake.

Response R3e: This assumption is not arbitrary but based on several experimental studies as cited in the risk assessment. It is agreed that this is a simplifying assumption applied as if all the volatiles present in groundwater volatilize equally. It was, however, applied only to those compounds which volatilize easily. The relative bioavailability, if relevant, was accounted for in the toxicity value applied for each route. It should be noted that the inhalation of volatiles from household uses of groundwater contributes relatively little to the overall risk from groundwater pathways.

Comment R3f: The estimate of PM10 in the air for an agricultural worker (35 mg/m^3) is excessive and unreasonable.

Response R3f: Tilling dry fields is a dusty activity. Whether it exceeds an OSHA limit is irrelevant. It is acknowledged, however, that the estimate derived in the risk assessment is conservative. The model used is a screening level procedure. Despite the use of this high-end estimate, there is no cause for concern from the site via this pathway and these results did not form the basis for the selected remedy.

Comment R3g: Endpoint specific estimates of noncarcinogenic hazard indices should have been developed.

Response R3g: It is appropriate to segregate the compounds by effect and/or mechanism if the HI is greater than one as a result of summing. That is, if the HI becomes greater than one because individual HQ values are each less than one. At this site, individual HQs for a number of chemical each exceed one, therefore this segregation step is not required.

Comment R4: Two commentors questioned the use of one-half the detection limit to estimate ground water concentrations. One indicated that the use of one-half the detection limit of compounds found in soil and leachate samples to estimate concentrations in groundwater violates EPA's guidance, which they believe is invalid between different media. (Miles, Himco Waste-Away Services/Mittelhauser)

Response R4: The Agency believes the use of one-half the detection limit is appropriate. The reference the commentor cites (RAGS pg. 5-10) is silent on the concept of "in a medium". It is true that the guidance does instruct the risk assessor to generally eliminate chemicals that have not been detected in any samples from a particular medium. It furthermore states that if information indicates that the chemicals are likely to be present in a medium, based on fate and transport mechanisms, they should not be eliminated. The guidance uses an example of soil contaminants that can leach to groundwater where those compounds have not yet been detected at some given laboratory quantification level. This concept has been similarly applied for the leachate. The term leachate, as used throughout the remedial investigation, may be somewhat misleading. In reality, this leachate is groundwater in contact with or contaminated by the waste material in the landfill. This leachate is highly contaminated as evidenced by the water samples taken from test pits when the water table was encountered. Although these chemicals have not been detected in the existing wells south of the landfill, there is the potential that these chemicals could migrate from the areas where they have been detected. In this case, the use of one-half the detection limit is an appropriate surrogate. The RAGS guidance clearly indicates that nondetects should not simply be eliminated from the risk assessment, or a value of zero be applied.

The detection limits presented in the tables in Appendix 2 of the risk assessment (range of nondetects) were reported by the analytical laboratories as contract-required detection limits, with adjustments for dilution and percent moisture made where applicable. These levels generally correspond to the limit of quantification. It is agreed that sample quantification limits are more relevant for evaluating nondetects. They were, however, not available. Instrument detection limits, however, are not suitable for use in a risk assessment since factors such as sample preparation, dilution, etc. are not considered.

It is true that this method of estimating exposure point concentrations indicated high risk levels from chemicals that may really be absent. On the other hand, they may be present at levels just below what the laboratory can measure, resulting in even higher risk than that calculated. This information was utilized in the risk management decision not to require treatment of the groundwater, but to further monitor the situation.

Comment R5: Total site risks were calculated and background risks were not excluded from risk estimates. (Miles)

Response R5: The Agency's RAGS guidance clearly instructs the risk assessor to calculate total site risk and suggests calculating background risk separately from site-related risk (RAGS, Pg. 5-18) if the risk assessor believes that background chemicals (or non-site-related chemicals) are significantly contributing to unacceptable risk. This is the methodology employed at this site. The results as presented in the risk assessment indicate that there is a portion of the total site risk attributable to background (either naturally occurring or upgradient sources). This information was considered in the risk management decision not to require treatment of the groundwater, but to further monitor the situation.

It is true that the Agency's Data Useability Guidance instructs the risk assessor that chemicals falling within naturally-occurring levels AND below a concentration of concern may be eliminated from the risk assessment. Since a number of naturally occurring chemicals were present at levels approaching a level of concern, no naturally occurring chemicals were eliminated from the risk assessment.

Comment R6: U.S. EPA improperly included leachate data to calculate ground water contamination. (Miles)

Response R6: As stated previously, in Response R4, above, the leachate is indeed contaminated groundwater. In calculating exposure point concentrations for groundwater in this area, a combination of leachate samples and groundwater wells in the proximate area were used to estimate the concentrations of these chemicals that would be available to a future hypothetical receptor. Based on the site subsurface data, it is possible that a pumping well installed in the landfill area will capture some leachate. However, because of the highly heterogeneous nature of the landfill, it is not possible to make a realistic prediction of how much and for how long leachate will be captured by the pumping well, therefore leachate data were included in the risk assessment for exposure to the groundwater under the future land-use scenario.

Comment R7: Chemicals detected infrequently should have been eliminated from the risk assessment and chemicals attributable to blank contamination should also be eliminated. (Miles)

Response R7: The commentor infers that application of a frequency of detect rule is required, when in fact it is an option. Guidance indicates "If conducting a risk assessment on a large number of chemicals is feasible...then the procedures in this section (including frequency of detection) should not be used" (RAGS, Pg. 5-20).

As stated on Page 2-7 of the Risk Assessment, an analysis of blank contamination was conducted according to EPA guidance. This guidance applies a "5X or 10X" rule for chemicals detected both in blanks and in the actual samples. Data points were thus modified as appropriate.

Comment R8: The toxicity assessment is incorrect because: 1) outdated toxicity values were used, 2) the TEF approach for PAHs was not used and 3) the oral absorption for beryllium was not addressed. (Miles)

Response R8: 1) The toxicity assessment was performed in April, 1992 using toxicity values current at that time. The Agency does not require the risk assessment be updated every time a toxicity value changes. The magnitude of the effect on the risk estimates for benzo(a)pyrene would not be significant considering that risk estimates are rounded to one significant figure. Neither does the Agency recommend the development of "site-specific" toxicity values.

2) There is no final Agency position as yet on the toxicity equivalency approach for PAHs. The approach remains under review. Therefore, the risk characterization for PAHs in this site risk assessment meets the current guidance, which is to apply the slope factor for benzo(a)pyrene to all carcinogenic PAHs.

3) The Agency recognizes that there is uncertainty involved in both estimating oral absorption factors for many chemicals, including beryllium, and in the current methodology for extrapolating toxicity values from an oral exposure route to a dermal exposure route.

The only dermal route quantified at this site was dermal exposures to groundwater while showering and incidental exposure to waders at the on-site ponds. While risks for the surface water exposures were well within an acceptable risk range, dermal exposures to groundwater, via beryllium were higher. They were nevertheless not significant when compared to other pathways involving exposures to groundwater. The considerable uncertainty in evaluating dermal pathways contributed to the risk management decision not to require treatment of the groundwater at this time, but to further monitor groundwater at the site.

Comment R9: Data validation procedures are not sufficiently documented. (Miles)

Response R9: As mentioned on page 2-6 of the risk assessment, data collected were reviewed and validated by U.S.EPA according to standard validation procedures for the Contract Laboratory Program. This validation was conducted by Region V's Central Regional Laboratory. Results of the validator's comments were incorporated into the database used for risk assessment calculations. As a result of this effort, a number of R-qualified data points were eliminated from use in the risk calculations. (R-qualified data points are data points which the data validator indicated are unusable because the presence of the compound in question cannot be verified.)

Comment R10: Major sources of uncertainty were not considered in the risk assessment, including unacceptable spike recovery data and the uncertainty due to the assumption of all chromium as hexavalent. (Miles)

Response R10: The Agency believes that uncertainties have been sufficiently documented. In the two examples cited by the commentor the following responses are offered:

1) The occurrence of an out of control spike does not necessarily warrant an unusable condition. Rather, affected data are generally "J" or "UJ" qualified, and as such are still usable for risk assessment purposes.

2) It is acknowledged that the assumption that all chromium occurs in the hexavalent form is conservative. This would be particularly relevant when quantifying an air pathway, since hexavalent chromium is considered carcinogenic; trivalent chromium is not. However, estimates of risk from these pathways were not significant when compared to total site risk and did not form the basis for the proposed remedy.

Comments regarding Site Characterization

Comment S1: All three commentors indicated that U.S. EPA failed to consider the effectiveness of the existing calcium sulfate cover and layering. (Miles, Himco Waste-Away Services/Mittelhauser, Geraghty & Miller)

Response S1: The analytical results of the leachate samples from the landfill indicate that the landfill contains wastes contaminated with organic and inorganic compounds. The proposed remedy for this site includes a composite cap to alleviate potential exposures to the landfill wastes. The commentors claim that the calcium sulfate waste dumped at the landfill is sufficient to eliminate present and future exposures to the landfill wastes and is protective of human health and the environment. U. S. EPA does not agree with this evaluation for the following reasons:

* The calcium sulfate layer has not been placed on the landfill under an engineering-controlled system as required by U.S. EPA and IDEM for a clay cover on a landfill.

* The thickness of the calcium sulfate layer is not sufficient in many areas of the landfill. The thickness was less than 2 feet in 62.5 percent of test pits excavated on the landfill.

* The chemical interaction between water and calcium sulfate make it less favorable as a cap material relative to most clayey materials.

Comment S2: One commentor provided a sworn affidavit of Mr. Jerry D. Perrin, former employee at the HIMCO Dump, taken on

November 30, 1992, in which he states, "I placed all the wastes between successive layers of soil and a material known as calcium sulfate." (Miles)

Response S2: Field observations of test pits do not confirm this statement. Twenty-four test pits were excavated in the landfill as a part of the RI for this site. Of these, eight test pits were observed to have alternating layers of calcium sulfate and waste (TD-3, TL-1, TP-9, TP-10, TP-11, TP-12, TP-13, and TP-20), indicating daily coverage of waste with a calcium sulfate layer. Alternating layers of waste and calcium sulfate were not observed in the majority of the test pits excavated in the landfill (16 of 24, or 66.7 percent). One possible explanation for the discrepancy between Mr. Perrin's statement and the actual field observations is the lag time between the landfilling operation and Mr. Perrin's employment with the Himco Dump. Mr. Perrin worked at Himco between 1970 and 1976; however, the site was in operation between 1960 and 1976. Based on the above information and the unbiased distribution of the test pits in the landfill area, it is apparent that daily coverage was not practiced in more than 50 percent of the landfilling operation.

Comment S3: In Mr. Perrin's affidavit, he states, "When the landfill was closed in 1976, Himco placed a final cover of calcium sulfate averaging at least two feet thick..." (Miles)

Response S3: This statement is not supported by the field data. The calcium sulfate cover thickness was found to be less than 2.0 feet in 15 of the 24 test pits excavated (62.5 percent). In addition, the calcium sulfate layer was less than or equal to 0.5 feet in five of the test pits on the landfill. Based on the above information and the unbiased distribution of the test pits in the landfill area, it can be concluded that a layer of calcium sulfate 2 feet or more thick has not been placed in more than half of the landfill area.

Comment S4: Assumptions used by U.S. EPA for compacted vegetative layers are inconsistent with accepted practice. (Geraghty & Miller)

Response S4: It is well documented on landfill closures and on mine reclamation projects that placement of vegetative support and topsoil layers by modern equipment will create greater compaction than most natural soil conditions. Agricultural tillage practices are typically designed around minimizing compaction; soil placement practices usually are not.

Regardless of the placement method, the use of compacted vegetative support layers in modeling reduces infiltration. The barrier layers can be modeled alone, and the results will still reflect that the composite system results in the least amount of infiltration.

We agree that excessive compaction can impact vegetative success, but this modeling task alone does not address technical specifications or the selection of vegetation species which can be successful.

Comment S5: Assumptions used by U.S. EPA for runoff curve numbers are inconsistent with accepted practice. (Geraghty & Miller)

Response S5: High curve numbers (CN) were used to emphasize the impact of the barrier layer. The lower the infiltration rate, the more efficient the barrier must be to prevent deeper infiltration. We agree that the CN could have been lower to reflect expected vegetative and soil conditions if construction is successful. To show that the composite liner still is the most effective, we re-ran the modeling with default values and with a CN of 95. In each case the vegetation layer was uncompacted. The following table shows the infiltration under various cap designs.

Annual Infiltration
Under Different Cap Designs

	CN=95 Poor Grass	CN=66 Poor Grass	CN=66 Good Grass
No Action (Zone A)	4.6 in.	4.6 in.	4.5 in.
Single Clay Cap	2.9 in.	7.2 in.	7.0 in.
Composite Cap	0.001 in.	0.001 in.	0.001 in.

The estimated higher infiltration for a single cap relative to the No Action Alternative is due to the errors associated with the numerical simulation of the infiltration. For example, the No Action Alternative depicts the top 1-inch of calcium sulfate as the vegetative layer with the remainder acting as a barrier soil. This creates a condition of increased runoff and lower soil water evapotranspiration. Accurate field data equating calcium sulfate to barrier soil properties would allow more accurate determinations to be made. None the less, the table shows that the composite cap provides the best protection against infiltration. Therefore, the composite cap option is the best performer.

Comment S6: Assumptions used by U.S. EPA for vegetative cover conditions are inconsistent with accepted practice. (Geraghty & Miller)

Response S6: The use of a full vegetative coverage in the modeling reduces the infiltration by modeling evapotranspiration. The poor cover is used to determine the effectiveness of the barrier rather than relying on successful vegetation to minimize infiltration. As is shown in the above table, the use of poor or good vegetative cover has minimal modeling impact on the infiltration rate. The composite cover is still the best available option.

Comment S7: Assumptions used by U.S. EPA for soil barrier texture number are inconsistent with accepted practice. (Geraghty & Miller)

Response S7: The use of the barrier soil with a HELP (model) texture number of 16 and 17 was performed. Texture 16 reflects a permeability of $1x10^{-7}$ cm/sec and texture 17 reflects $1x10^{-8}$ cm/sec. The modeling results with a CN=66, poor grass, and no compaction of vegetative layers are summarized in the following table:

Single Clay

Soil Barrier	Infiltration
Texture 16	1.25 in.
Texture 17	0.13 in.

Published papers have documented that a field permeability of $1x10^{-7}$ cm/sec is difficult to achieve. It is our opinion that $1x10^{-8}$ cm/sec would not be achievable on a landfill cover due to an unstable foundation (waste) and long-term vegetation and animal impacts.

However, modeling still shows that a single clay cap is less effective than a composite cover. With the absence of a base liner, leachate extraction system, and the close proximity to groundwater, U.S. EPA believes the cover must provide the best restriction to infiltration. If a cost-benefit analysis is required to predict how much infiltration is allowable, the HELP modeling will not give that answer. Source control has been proven as the most effective control of potential groundwater contamination; therefore, since source removal is not part of the selected remedy, the most effective cap should be employed.

Comment S8: One commentor provided a lengthy, admittedly "obviously idealized" characterization of the hydrogeology of the landfill, concluding that the landfill area had been "silted in" prior to landfilling, which, in effect, created a natural liner under the landfill. The commentor states that SEC Donahue failed to identify this natural liner. (Himco Waste-Away Services/Mittelhauser)

Response S8: U.S. EPA feels this portrayal of the landfill hydrogeology is not accurate for the following reasons:

* The high permeability glacial outwash deposits in the region, and man-made structural barriers (e.g., roads, trenches, etc.) prevent excessive surface runoffs in the site vicinity. These features do not support the hypothesis of standing water in the landfill area and the resulting formation of a natural silt/clay liner during its geologic history prior to the landfill operation at the Himco site.

* Aerial photographs taken in August 1965, when landfilling occurred in an approximately 6.5-acre area southeast of the site, show no standing water in the landfill area.

* All borings preformed in and around the site (e.g., B-1, B-3, B-8, B-11, E-1, B-7, M-1, M-2) (see Figures 3-9 and 3-11 of the RI report) without exception show no silt and clay layers at the approximate base elevation of the landfill. All of the borings indicate sand and gravel deposits classified as SP or SW in the Unified Soil Classification System, extending from surface to the bottom elevation of the borings. Silt and clay layers occasionally were encountered in the borings; however, none were encountered at the level corresponding to the base of the landfill (an approximate elevation of 755 feet MSL).

Comment S9: One commentor provided a discussion regarding the PAH compounds determined to be present in the south portion of the landfill, conjecturing that they may be attributable to peat or to asphalt, since they believe no coal tar wastes were disposed of in the landfill. (Himco Waste-Away Services/ Mittelhauser)

Response S9: The source of the PAH compounds found in the south portion of the Site was not determined. Presumably, they were disposed during landfill operations. In any case, they are hazardous substances that have come to be located on a Superfund site and have been determined to present a significant risk and therefore, must be remediated.

Comments on the No Action Alternative

Comment N1: The remedial action objectives are fully satisfied by No Action. (Miles, Geraghty & Miller, Himco Waste-Away Services/Mittelhauser)

Response N1: The results of the RI indicate that the waste mass is contaminated by VOC's, SVOCs and inorganics. The results of the baseline risk assessment indicate unacceptable carcinogenic and/or noncarcinogenic risks for human exposures to the landfill contents, primarily due to exposure to highly contaminated groundwater, i.e., leachate. The FS identified remedial action objectives (RAOs) for the Himco site (page 2-2 of the FS). None of these objectives are met by No Action.

* Direct contact with the landfill wastes is not prevented. The suggestion that the inclusion of calcium sulfate as cover material has resulted in the construction of an engineered waste encapsulation unit is not correct. Field logs do not confirm uniform grading of a calcium sulfate cap that would meet today's standard for landfill closure activities.

* Groundwater usage in the site vicinity is not controlled by No Action, as a new well was just installed south of the landfill while the RI/FS was undertaken.

* The calcium sulfate cover does not effectively control leachate generation in the landfill. No Action would allow the continued percolation of rainfall across the landfill.

* No Action would allow the continuing migration of contaminants from the waste mass to the groundwater beneath the site and would allow the migration of VOCs and noxious odors from the site due to the lack of vapor controls from the landfill.

* The long-term cap integrity will not be maintained because surface runoff control and a gas collection system will not be implemented under the No Action alternative.

Comment N2: U.S. EPA failed to develop the No Action alternative. One commentor requested that U. S. EPA reexamine the ARARs compliance of the No Action Alternative. (Miles, Geraghty & Miller, Himco Waste-Away Services/Mittelhauser)

Response N2: The No Action alternative has been adequately evaluated, along with three other alternatives, in the FS reports. Each alternative was evaluated against the nine criteria established by the NCP for detailed analysis of alternatives. Table 4-5 of the FS report presents a summary of this evaluation. The No Action alternative does not achieve the threshold criterion of overall protection of public health and the environment. The No Action alternative would not be protective of human health and the environment for the following reasons:

* The calcium sulfate cover is not in compliance with today's standards for caps on landfills and would allow the continued percolation of rainfall across the landfill. Although the calcium sulfate does retard the percolation of rainfall across the landfill, the calcium sulfate was not

placed in the landfill uniformly, so the potential for channeling and leakage of infiltration into the landfill is high.

* The calcium sulfate cap is prone to dissolution and erosion as a result of surface water percolation into the landfill. This effect was observed in some test pits performed in the landfill. The test pits showed calcium sulfate thickness of less than 6 inches.

* The chemical interaction between water and calcium sulfate make it less favorable as a cap material relative to most clayey materials.

* The No Action alternative would allow the migration of VOCs and noxious odors from the site due to the lack of vapor controls in the landfill. EPA received frequent complaints from the residents in the vicinity of the landfill regarding odors from the landfill. One such complaint was voiced in the public meeting for the proposed plan.

* The No Action alternative would allow direct contact with the landfill waste material which is contaminated with both organic and inorganic compounds. The test pits performed during the RI showed calcium sulfate cover thickness of equal or less than 6 inches in five test pits and less than 2 feet in 62.5 percent of the test pits.

* The No Action alternative would allow other potential risks as described in the FS report.

The No Action Alternative does not have to be carried through the comparative analysis if it is shown that it does not pass the threshold criteria. Clearly, the No Action Alternative does not pass these criteria for the HIMCO Dump Site.

Comments regarding Other Remedial Alternatives

Comment O1: U.S. EPA failed to ensure that appropriate remedial alternatives are developed. (Miles)

Response O1: The FS report systematically evaluates an array of remedial technologies, formulates a range of alternatives, and screens the developed alternatives in detail according to the guidelines presented in both Conducting RI/FS for CERCLA Municipal Landfill Sites and Guidance for Conducting RI/FS under CERCLA. Each of the alternatives, including No Action, were fully developed and evaluated in the FS report.

The only difference between the Himco FS and a typical FS is that screening a universe of technologies, as suggested under EPA's guidance for the RI/FS, was not included in the Himco FS. This approach was undertaken because landfills have similar characteristics and EPA has, based on its experience and according to guidance, established a number of expectations as to the type of remedial alternatives to be evaluated for municipal landfills.

<u>Comment O2:</u> One commentor stated that the need for an active landfill gas collection and treatment system has not been demonstrated. (Geraghty & Miller)

<u>Response O2:</u> U.S. EPA acknowledges that the gas generation rate in the Himco site is not like typical municipal landfills as a result of the high volume of calcium sulfate waste disposed of at this site. However, considerable gas generation has been documented for this site. For example, the air monitoring performed as a part of the safety requirements during installation of test pits showed high levels of organic vapor and presence of hydrogen sulfide (H_2S). Additionally, numerous complaints regarding odor have been expressed by residents in the vicinity of the landfill. One such complaint was voiced in the Proposed Plan public meeting. In addition to gas generation due to the decomposition of non-calcium sulfate wastes, it is also likely that the reduction of sulfates to hydrogen sulfide under anaerobic conditions within the landfill is a source of the odors noted at this site. Based on this information, the FS included gas remediation as a part of the selected remedy for the Himco site.

In calculating the gas generation rate, only one third of the material in the landfill was used as possible methane producing material. As presented in the Technical Memorandum A5, the total gas generation rate ranged from 6.68×10^6 SCF/yr to 66.8×10^6 SCF/yr or equivalent to 0.010 SCF/lb/yr to 0.1 SCF/lb/yr. If the factor of 1/3 gas-producing waste volume (0.02 to 0.3 SCF/lb/yr) would be considered, the range encompasses the figure 0.15 SCF/lb/yr indicated by the commentor as a "typical gas generator rate" in the landfill.

It should be noted that the result of the gas generation rate did not have a significant effect on the selected remedy or cost estimate for the selected remedy.

<u>Comment O3:</u> One commentor stated that they believe the costs given in the FS Report for the two capping systems appear to be underestimated. (Geraghty & Miller)

<u>Response O3:</u> The quotes used in estimating capping costs are documented in Appendix B4 - Index of Telephone Logs of the Final Feasibility Study Report for the Himco Dump Superfund Site. The quote taken from a local vendor only includes the soil material

and haul costs, as stated in the telephone log. Similar quotes were received from other local vendors for soil material and haul. The costs for placement and compaction of this material are included in the cost estimate for capping at this site (see Appendix B1 Cost Assumption tables). The costs for placement and compaction were compiled from the Means Heavy Construction Cost Data, 1992 (Means). Because the quotes that were received were low relative to estimates from Means, estimates from Means for material and haul were used as the Upper Limit value in the cost Sensitivity Analysis in the FS.

Comment O4: One commentor stated that the leachate collection system described in Alternative 3 is ill-conceived and not well-thought out. (Himco Waste-Away Services/Mittelhauser)

Response O4: U. S. EPA does not agree with the commentor's assertion that the Agency does not have a basic understanding of the Site hydrogeology. The commentor provided little more than conjecture, without technical information to back it up, that the leachate collection system is not well designed.

Because there is no aquitard under the HIMCO Dump to isolate the waste mass from the aquifer and the waste mass is in contact with ground water at least part of the year, it was judged that the leachate collection system would need to consist of vertical wells distributed throughout the whole landfill area to capture the leachate.

Comment O5: One commentor stated that the Selected Remedy is inconsistent with the NCP because it is not cost-effective. (Miles)

Response O5: Cost effectiveness is determined by evaluating overall effectiveness, which is based on long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, and short-term effectiveness. U.S. EPA believes that the Selected Remedy is cost-effective because it provides the best balance of these three criteria and the cost is proportional to the overall effectiveness. The Agency does not agree with the commentor's assertion that No Action is appropriate, or that institutional controls provide the same remedial value as the proposed cap. The Agency's rationale has been explained in previous responses.

Summary of Other Comments Received

Comment S1: The Conclusions of the RI/FS and U.S. EPA's Proposed Remedy are Arbitrary and Capricious and Contrary to Law. (Miles)

Response S1: The Agency does not agree with the commentor that it acted arbitrarily and capriciously in the performance of the

RI/FS or in its selection of a remedy for the HIMCO Dump Site.

Comment S2: Two commentors indicated that U.S. EPA failed to conduct a proper Preliminary Assessment in violation of the NCP. One commentor concluded that because significant contamination was not found in the ground water during the RI, the sample results used for the HRS score were in error. (Miles, Himco Waste-Away Service/Mittelhauser)

Response S2: U.S. EPA does not agree with these assertions. No evidence is given to substantiate the assertion that past sampling events were in error or that a proper PA was not conducted. The PA/SI sample collection was performed in accordance with NEIC Manual for Groundwater/Subsurface Investigations at Hazardous Waste Sites. Sample preservation and analysis were performed according to CLP procedures. The HRS scoring process includes rigorous quality assurance procedures, which the HIMCO Dump Site passed.

Comment S3: Two commentors indicated that sites which pose no significant risk to public health or the environment should be deleted from the NPL. They assert that the HIMCO Dump Site is such a site. (Miles, Himco Waste-Away Services/Mittelhauser)

Response S3: U.S. EPA agrees that sites that pose no risk to public health or the environment should be deleted from the NPL. However, the Agency does not believe that the HIMCO Dump Site does not pose a risk. The responses to Comments N1 and N2 detail the Agency's position on this issue.

Comment S4: One commentor stated that "Miles and Himco are prepared to fund the erection of an appropriate fence to further prevent site access and to fund reasonable groundwater monitoring. While these controls are unnecessary given the complete lack of a risk at Himco, Miles and Himco are prepared to fund these efforts to address the public concern at the site." (Miles)

Response S4: U.S. EPA thanks Miles and Himco for their offer. However, as stated in the Record of Decision and the above responses to comments, the Agency clearly does not believe that the actions proposed by Miles and Himco are an acceptable remedy for the HIMCO Dump Site.

APPENDIX M

REMEDIAL ACTION

HIMCO DUMP SUPERFUND SITE

ELKHART, INDIANA

APPENDIX M

90 PERCENT DESIGN COMMENTS

HIMCO DUMP SUPERFUND SITE
90 PERCENT REVIEW COMMENTS AND RESPONSES

NO	DOCUMENT & SECTION	COMMENTOR	COMMENT	RESPONDER	RESPONSE
1	*Construction Quality Assurance Plan General*	IDEM T. Likins	No Quality Assurance Project Plan for construction was submitted for review. This is a necessary document which must be approved prior to the completion of remedial design activities.	CENWO-ED-GB R. Taylor	Concur. A Construction Quality Assurance Plan will be prepared and submitted as requested.
2	*Design Analysis & Specifications* General	IDEM T. Likins	No information is given for ambient air quality monitoring during construction and O&M activities. This is necessary to ensure compliance with ARAR's. Further, Elkhart County is an Ozone non-attainment area. This can present another ARAR problem.	CENWO-ED-EH D. Morrissey	Noted. Based on review of Federal and State of Indiana regulations, ambient air quality monitoring is not required from an ARAR perspective. Consequently, perimeter air monitoring specification is not required. However, from a public and occupational health perspective, fugitive dust, VOCs, and in particular methane gas emissions, are important to monitor for during intrusive construction activities. The provision for real-time monitoring for methane in the area with pre-set action level at not to exceed 25% of the LEL in air (by volume) will be added to the Safety, Health, and Emergency Response Specification.
3	*Design Analysis* Section 2 Para 5.4	CENWO-HX-G G. Mellema	I'm concerned about the low overall methane concentrations, that it will be difficult to get extracted landfill gas to burn. It may take quite a bit of supplemental fuel to burn in the flare. Not sure of the answer to this, may need to talk with the mechanical designers, it may be possible for an alternate treatment system.	CENWO-ED-DB R. Guziec	Noted. Provisions have been added to the specifications to allow for future hook-up of a supplemental fuel source int he event it is needed.
4	*Design Analysis* Section 3 Para 1.1.9.4	CENWO-HX-G G. Mellema	Second to last sentence. HDPE is sensitive to higher temperatures, and loses significant strength at temperatures around 140 degrees F. Temperatures should be checked during drilling if possible. If temps are high, a different screen material should be used. I wouldn't expect high temps due to the high water table and relatively shallow depths of waste materials.	CENWO-ED-GB R. Taylor	Based on the composition of the waste material (i.e., primarily construction debris and calcium sulfate and smaller amounts of municipal waste all mixed with local soils), along with the limited thickness of the wastes and waste age, temperatures high enough to damage the HDPE are not anticipated. The detail will be revised however to show large slot perforations to minimize the potential for the slots to close due to temperature or other induced deformations. In addition, PVC will be specified as the downhole well material instead of HDPE. According to ETL 1110-1-160, Landfill Off-Gas Collection and Treatment Systems, approximately 88 percent of vertical well pipes are constructed with PVC. This will result in changes to Drawing GD.02; Landfill Gas Extraction Well Details and Specification 02252; Landfill Gas Extraction Wells and Trenches.

HIMCO DUMP SUPERFUND SITE
90 PERCENT REVIEW COMMENTS AND RESPONSES

NO	DOCUMENT & SECTION	COMMENTOR	COMMENT	RESPONDER	RESPONSE
5	*Design Analysis* Section 3 Para 1.1.9.5	CENWO-HX-G G. Mellema	Gas Well Spacing. Due to the flat cover slopes, very little gas will migrate naturally to the crest of the cap. Delete sentence.	CENWO-ED-GB R. Taylor	Some gas movement due to differential pressure gradients will occur. However, in order to more effectively control gases that are generated, the horizontal collector trenches will be separated and valved to allow for specific operation of sections of each trench in a manner similar to the vertical extraction well system so that high gas producing regions can more easily be targeted. To accomplish this, the trench piping will be separated into approximately 300 foot-long sections which are connected to a common header with each section having a manifold system similar to the vertical wells. This will result in changes to Drawings G8.01 and G8.02, Landfill Gas Collection System Plan, Sheets 1 and 2; and GD.08, Landfill Gas Collection System Typical Details and Cross-Sections; and Specification 02252, Landfill Gas Extraction Wells and Trenches.
6	*Design Analysis* Section 3 Para 1.1.9.7	CENWO-HX-G G. Mellema	Header Pipes. Verify the pipe sizes for the extraction system. The pipes seem to be quite large and perhaps smaller and/or lighter (Sch. 40) lines will perform just as well.	CENWO-ED-GB R. Taylor R. Guziec	The header pipe sizes allow for unwanted partial blockage of the header system (e.g., condensate pooling in low areas of the pipe that experience differential settlement). The headers need to be this large to keep the pressure losses low. In addition, the header pipe sizes allow for expansion of the system in the future if needed.
7	*Design Analysis* Section 3 Para 3.3.1	IDEM T. Likins	More investigation is necessary to verify the assumption made concerning the necessary retention time of condensate within the LGAC unit. Also, it is stated that low molecular weight VOCs may not be effectively removed by the LGAC unit. This may present a problem with the planned discharge to the POTW. It is conceivable that the condensate, after the appropriate analytical testing, could meet the criteria of a hazardous waste. This would require a more expansive, and expensive, disposal plan than is included here.	CENWO-ED-DK O. Nalbant	-Carbon manufacturer indicates a retention time of 8-10 minutes (which is also the minimum recommended) can be maintained at a flow rate of 5 gpm. Since the design flow rate is less than 1 gpm, the minimum retention time will be achieved. - Estimated VOC concentration in the condensate is 0.68 mg/l (fairly low). Refer to Appendix G for calculations. The condensate is not anticipated to be hazardous.
8	*Design Analysis* Section 3 Para 3.3.1	CENWO-HX-G G. Mellema	Condensate. The estimated flow rate is 600 gallons per day, requiring a 15,000 gallon tank. This seems unusually high, show calcs for this estimate. A municipal landfill near Des Moines, similar in size, but much deeper wastes, utilizes a 10,000 gallon tank which is adequate for a month or so.	CENWO-ED-DK O. Nalbant	Supporting calculations are provided in the Mechanical Appendix. A larger tank would require less service (i.e., emptying, etc.) If the estimated condensate flow rate is overestimated.

HIMCO DUMP SUPERFUND SITE 90 PERCENT REVIEW COMMENTS AND RESPONSES					
NO	**DOCUMENT & SECTION**	**COMMENTOR**	**COMMENT**	**RESPONDER**	**RESPONSE**
9	*Design Analysis* Section 3 Para 6.7.4	IDEM T. Likins	"Presently, the only spillway from the North Borrow Area is for water to back up through the 30" RCP into the residential area east of the HIMCO site during a big storm. A flap gate will be installed, but may not help reduce water levels in the neighborhood east of the road." This could cause inconvenience and/or risk to the residents of this area due to flooding, insects, etc. Further, any residents still using private wells in this area could be at risk by ground water flow fluctuations caused by heavy run-off on-site during peak flow periods, as well as contamination brought on by the flooding of surface waters from the site. These possibilities need to be considered.	CENWO-ED-HE M. Nelson	The possibility of inconvenience and/or risk to the residents of this area due to flooding etc. was considered. Several steps were taken to reduce the problem in events more common than the 25 year event. In the case of flooding less common than the 25 year event, residents in the area would be flooded and inconvenienced by runoff and ponding from many sources other than just blockage by the flap gate and pond on the HIMCO site, thus additional efforts to reduce ponding in the neighborhood could be ineffective and expensive. The effect that ground water fluctuations and surface runoff have on private wells was not considered in the analysis. The water table was shown to fluctuate significantly prior to this design effort, so potential for contamination should not be increased, once the cap is in place. Also, the flap gate should prevent surface water from the site from backing up into the neighborhood to the east. The North Borrow area was increased in size and its contributing drainage area mad smaller in order to reduce the frequency that the flap gate would impede drainage from the neighborhood to the site. The possibility of routing infrequent (25 year) high water from the North Borrow Area westward via a ditch or pipe, through the West Borrow Area into Manning Ditch was considered. However, it was found that ground water levels were actually higher to the west so any connection between the two ponds would result in flow going the "wrong way" and increasing the volume of water stored in the North Borrow Area. Given the flow direction, pumps and storm sewers would likely be required to get rid of excess water during extremely wet periods. If the flap gate is installed as recommended, it will be difficult for runoff from the landfill cap to enter the neighborhood. Well data collected in the 1980's shows that the ground water table fluctuates several feet over time, and is usually close to the surface. Short term heavy run-off from the cap will not likely later the existing pattern of water table fluctuation to any extent as the entire are would experience a ground water gain during a storm. No changes required to the documents.

HIMCO DUMP SUPERFUND SITE
90 PERCENT REVIEW COMMENTS AND RESPONSES

NO	DOCUMENT & SECTION	COMMENTOR	COMMENT	RESPONDER	RESPONSE
10	*Design Analysis* Section 3 Para 7.1.2	IDEM T. Likins	It is stated that concern still exists for exposure to contaminants associated with the site. However, no specific information was provided as to the nature of these contaminants, the area most likely to present an exposure problem, and what safety and remedial measures will be implemented to eliminate the potential for exposure. More explanation and possible solutions need to be included here.	CENWO-ED-EH D. Morrissey	*Refer to section 3.14 of the Design Analysis. Most of these* questions have been answered in the referenced section. The Design Analysis is the written logic for decisions made in the specifications. Any solutions to be provided by the contractor will be found in the SSHP when it is submitted.
11	*Design Analysis* Section 3 Para 8.2	CENWO-HX-C J. Solsky	It would be recommended that the new version of ER 1110-1-263 be referenced. The new version is dated 1 April 1996.	CENWO-ED-EG N. Narraine	Concur. The newer version will be referenced.
12	*Design Analysis* Section 3 Para 8.2.1.1	CENWO-HX-C J. Solsky	It would be recommended that the outline for the QAPP be taken from EM 200-1-3 (dated 1 Sep 1994). That outline is defined as follows: Title Page; Table of Contents; (1) Project Description); (2) Project Organization and Responsibility; (3) Data Quality Objectives; (4) Sampling Locations and Procedures; (5) Sample Custody and Holding Times; (6) Analytical Procedures; (7) Calibration Procedures and Frequency; (8) Internal QC Checks; (9) Calculation of Data Quality Indicators; (10) Corrective Actions; (11) Data Reduction, Validation, and Reporting; (12) Preventative Maintenance; (13) Performance and System Audits; and (14) QC Reports to Management.	CENWO-ED-EG N. Narraine	The Contractor's QAPP outline will follow the EPA requirements. The USACE requirements are only applicable to Corps "fund lead" projects, not Superfund PRP projects.
13	*Design Analysis* Section 3 Para 8.2.1.2	CENWO-HX-C J. Solsky	The following statement was made: 'Sensitivity and detection limits of the methods shall be sufficient to meet all regulatory requirements.' A better statement would be as follows: 'Laboratory reporting shall be at least a factor of two below the applicable regulatory requirements.' Laboratory reporting limits cannot be lower than three to five times a laboratory's method detection limit (MDL). For each of the subsection within this section, the laboratory should be made aware of the specific target analyte lists for each method.	CENWO-ED-EG N. Naraine	Concur, the DA will be changed.

HIMCO DUMP SUPERFUND SITE
90 PERCENT REVIEW COMMENTS AND RESPONSES

NO	DOCUMENT & SECTION	COMMENTOR	COMMENT	RESPONDER	RESPONSE
14	*Design Analysis* Section 3 Para 8.2.1.2.7.1	CENWO-HX-H M. Fisher	I do not recommend the use of a perimeter air monitoring system to characterize emissions during operations and maintenance (O&M). The only source of emissions during O&M will be the landfill gas treatment system and as currently specified, there are requirements to monitor performance of the treatment system at the outlet of the GAC filter. Generally speaking, a perimeter air monitoring system is a very poor system for monitoring emissions from point sources.	CENWO-ED-EG N. Narraine	Concur. A point source emissions monitoring scheme will be utilized for flare emissions.
15	*Design Analysis* Appendix A Page A-56	IDEM T. Likins	States "Assume same time frames as for old waste layer (i.e. 1976 to 1996 and 1996 to 2026)." The time interval from 1976 to 1996 is twenty years, from 1996 to 2026 is thirty years. This calculation should be re-checked and corrected if necessary.	CENWO-ED-GB R. Taylor	The calculations are correct as provided in the Appendix. Calculation of settlement is based on a logarithmic relationship developed by Sowers that takes into account the decomposition of organics in municipal waste. Over time, decomposition of waste decreases as the organic fraction diminishes due to biological activity. Consequently, over time the magnitude of consolidation of the waste mass decreases (i.e., more settlement occurs in years 1 through 20 than occurs in years 20 to 50). The calculation models the historic decomposition of the waste mass (i.e., The first 20 years after placement from 1976 to 1996) and subtracts this from the additional consolidation of the waste mass in future years (i.e., 1996 to 2026). By doing so, historic consolidation of waste materials due to organic decomposition that theoretically has already occurred is not considered as additional consolidation for the post-closure period. No changes required to the documents.
16	*Design Analysis* Appendix A Page A-58	IDEM T. Likins	States "Total expected settlement of final cover at center line STA 5+00 (ST= 3+1"=4")". The effects of swell where waste and clean borrow material has been excavated and placed could affect the volume of material handled and subsequent settlement calculations. It is expected that "handled" waste material can have up to 10% more volume or swell than the normal settlement process for clean "handled" sediments. The affects of this upon compaction, settlement, and final grade should be addressed.	CENWO-ED-GB R. Taylor	The settlement calculations assume that the material will be placed as an engineered fill. This means that the excavated material will be placed and compacted using standard construction equipment. Specification 02211, Excavation, Initial Grading, and Random and Foundation Fill for Landfill requires that excavated waste material be compacted with a minimum of 3 passes of a standard municipal landfill trash compaction equipment. Random and foundation fills requires compaction to specific density requirements. The compaction requirements in the specifications are used to achieve a stable waste/soil mass under the cover system. As specified, there will be no areas of loosely dumped soil or waste that would be susceptible to excessive consolidation and corresponding unacceptable differential settlements of the cover system.
17	*Design Analysis* Appendix F	CENWO-HX-G G. Mellema	Several pages are missing from the appendix. Include for next submittal.	CENWO-ED-GB R. Taylor	Concur. Missing pages will be submitted.

HIMCO DUMP SUPERFUND SITE
90 PERCENT REVIEW COMMENTS AND RESPONSES

NO	DOCUMENT & SECTION	COMMENTOR	COMMENT	RESPONDER	RESPONSE
18	*Specifications* Spec No. 01402 Section 1.2.2	CENWO-HX-C J. Solsky	It would be recommended that Final Update II for SW-846 be referenced since Update II has now been promulgated for about one year now.	CENWO-ED-EG N. Naraine	Concur. Will make appropriate changes.
19	*Specifications* Spec No. 01402 Section 3.2.5	CENWO-HX-C J. Solsky	The following statement was made: 'Sensitivity and detection limits of the methods shall be sufficient to meet all regulatory requirements.' A better statement would be as follows: 'Laboratory reporting shall be at least a factor of two below the applicable regulatory requirements.' Laboratory reporting limits cannot be lower than three to five times a laboratory's method detection limit (MDL). For each of the methods listed, it would be recommended that specific target analyte lists be provided. Specific extraction/digestion methods and any associated clean-up methods should be specified.	CENWO-ED-EG N. Naraine	Concur. Will make appropriate changes.
20	*Specifications* Spec No. 01402 Section 3.2.13.3	CENWO-HX-C J. Solsky	See previous comment regarding 'sensitivity and detection limits.'	CENWO-ED-EG N. Naraine	Concur. Will make appropriate changes.
21	*Specifications* Spec No. 01402 Section 3.2.13.5.2	CENWO-HX-C J. Solsky	This section discusses data validation and the necessity that it be close to and independent of the data production process. This section is confusing as now written. It would be recommended that it [be] deleted since the topic is addressed in parts of later sections, or expanded to include a better description of the data review and data validation process. The laboratory should use at least a three-tier level of data review; Level I or analyst review, Level II or Pier Review, and Level III or administrative review. A QA review would also be conducted at the laboratory that would independently review the data. Once the data was released by the laboratory, the A/E would review the data and part or all of the data may then be validated by an independent third party.	CENWO-ED-EG N. Naraine.	Concur. Will make the appropriate changes.
22	*Specifications* Spec No. 01402 Section 3.2.6	CENWO-HX-H M. Fisher	It is unclear why sampling and analysis of gas collection condensate is required in this paragraph and in 3.2.8. From what is written it looks like the designer is intending to characterize the influent to and effluent from the GAC filtering system used to remove nonmethane VOC's from the landfill gas stream. If this is the case then it would be best to use method 25A from 40 CFR 60 Appendix A.	CENWO-ED-EG N. Naraine	Concur. Will change the method as suggested. The specs will also be clarified to state that paragraph 3.2.8 is testing to characterize the condensate inside the tank.

HIMCO DUMP SUPERFUND SITE *90 PERCENT REVIEW COMMENTS AND RESPONSES*					
NO	DOCUMENT & SECTION	COMMENTOR	COMMENT	RESPONDER	RESPONSE
23	*Specifications* Spec No, 01402 Section 3.2.7	CENWO-HX-H M. Fisher	The flare used to treat methane generated by the landfill. If the GAC is working properly, the VOC's should be removed prior to reaching the flare. It is pointless to sample and analyze for compounds that will not be present. Delete the VOC and SVOC sampling and analysis requirements for influent and effluent from the flare.	CENWO-ED-EG N. Naraine	Disagree. The tests are to verify that the GAC is operating properly. The influent and effluent to the flare from the vapor phase GAC unit needs to be analyzed and that is what these tests are for. The State ARARs require that VOCs and SVOCs be monitored at the flare.
24	*Specifications* Spec No. 01432 General	CENWO-HX-H M. Fisher	The attached evaluation indicates that there is no reason to include perimeter air monitoring (above grade) for volatile organic compounds. Vinyl Chloride emissions fall within acceptable risk range at the nearest receptor. My suggestion is to remove requirements for perimeter air monitoring. Monitoring requirements for gas monitoring probes (below grade) should remain unchanged. [Noted evaluation of perimeter air monitoring is not attached to this document.]	CENWO-ED-EH N. Naraine	Disagree. First of all the comment doesn't state whether the commentor is proposing to remove the perimeter air monitoring for VOCs during construction or O&M or both. The perimeter air monitoring must be done during construction. The flare will have monitoring performed at its location because it is a point source. From the calculations presented by the commentor, the most conservative concentration of vinyl chloride anticipated exceeds the 0.0001 action level from the EPA Region III RBC table.
25	*Specifications* Spec No. 11240 General	CENWO-HX-E E. Mead	Per a Henry Law equil calc, I guesstimate the concentration of the VOC's in the condensate to be 0.68 mg/l. Suggest this be checked after startup to see if the POTW will accept this condensate without carbon treatment.	CENWO-ED-DK O. Nalbant	The O&M document indicates that the LGAC units will be bypassed if VOC concentrations would consistently below the POTW's limits during the initial 6-month period.
26	*Specifications* Spec No. 11240 Section 1.3	CENWO-HX-E E. Mead	Spare Parts: Add the following paragraphs from the carbon guide spec 11225 (available in the Internet, MRD Home Page HTTP://www.mrd.usace.army.mil), HTRW-CX, Engineering at CS icon, published guidance, GS11225): 11225-8/SD-01 b. Instrumentation *Activated Carbon*\ paragraph *Adsorption Battery Components*\ paragraph	CENWO-ED-DK O. Nalbant	The subject paragraphs have been added.
27	*Specifications* Spec No. 11240 General	CENWO-HX-E E. Mead	Add SD-13 information from GS11225 in Internet.	CENWO-ED-DK O. Nalbant	Added.
28	*Specifications* Spec No. 11240 Section 1.5	CENWO-HX-E E. Mead	Add 1.5.2.5.2. Single Source Supplier from 11225.	CENWO-ED-DK O. Nalbant	Added.

HIMCO DUMP SUPERFUND SITE
90 PERCENT REVIEW COMMENTS AND RESPONSES

NO	DOCUMENT & SECTION	COMMENTOR	COMMENT	RESPONDER	RESPONSE
29	*Specifications* Spec No. 11240 Section 2.6.2.1	CENWO-HX-E E. Mead	Are other surface coatings such as epoxy acceptable as vessel interior coatings? Only specifying vinyl ester is quite restrictive.	CENWO-ED-DK O. Nalbant	Option for using different surface coating recommended by the mfgr. has been added.
30	*Specifications* Spec No. 11240 Section 2.11.1	CENWO-HX-E E. Mead	Add: Head loss in each unit at rated flow shall not exceed {4} [8] [10] [12] [____] psig when filled with fresh media.	CENWO-ED-DK O. Nalbant	See drawing M1.4. The mechanical schedule shows that the pressure drop for the water phase carbon absorber is 1 psi at 10 gpm. This (1 psig) also added in the specs.
31	*Specifications* Spec No. 11240 Section 3	CENWO-HX-E E. Mead	Add 3.7 Manufactures Services from GS11225.	CENWO-ED-DK O. Nalbant	Added.
32	*Specifications* Spec No. 11240 Section 3.2	CENWO-HX-E E. Mead	Equipment installation - this needs clarification.	CENWO-ED-DK O. Nalbant	Clarified
33	*Specifications* Spec No. 11240 Section 3.2	CENWO-HX-E E. Mead	Add 3.2 Pipe, valves, fittings...from the attached page 11225-23 of the carbon guide spec. [noted page is not attached]	CENWO-ED-DK O. Nalbant	Added.
34	*Specifications* Spec No. 11240 Section 3.4.1	CENWO-HX-E E. Mead	Surface prep: Move this to Sect 09900 and reference that section.	CENWO-ED-DK O. Nalbant	The referenced info. was left in Section 11240.
35	*Specifications* Spec No. 11240 Section 3.4.3	CENWO-HX-E E. Mead	Using only epoxy-polyamide paint is very restrictive. Are there other such epoxy that are acceptable?	CENWO-ED-DK O. Nalbant	An alternative has been added for the contractor to use a different paint system recommended by the carbon manufacturer.
36	*Specifications* Spec No. 11240 Section 2.2.1.1	CENWO-HX-E E. Mead	Section 01402 should also require a complete cation/anicn balance of all major ions (Fe, Mn, Ca, Na, SO4, HCO3, CO2, Cl, and pH. These chemicals can, for example, cause precipitation in the carbon and other units in the process. The equipment vendors may need this information.	CENWO-ED-DK O. Nalbant	The information on the cation-anion balance is not critical since the LGAC units have been oversized.
37	*Specifications* Spec No. 11241 General	CENWO-HX-E E. Mead	References 3.2.1, 3.2.3, and 3.2.4 do not exist.	CENWO-ED-DK O. Nalbant	Paragraphs 3.2.1 and 3.2.3 have been added. However, paragraph 3.2.4 was not found in the original carbon spec (11225) and therefore was not added.

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38	*Specifications* Spec No. 11241 General	CENWO-HX-E E. Mead	Add the para: Standard products, materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturer of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Materials and equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. and Nameplates on major equipment items such as adsorption shells, blowers, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.	CENWO-ED-DK O. Nalbant	Added.
39	*Specifications* Spec No. 11241 Section 1.8.1.1	CENWO-HX-E E. Mead	Breakthrough of H2S in the pilot study is proposed to be done by olfactory sensing. The concentration of H2S in the landfill is not reported (the DA reports CS2 but not H2S). Check to be sure it *should not* be H2S. The DA also mentions the conversion of H2S to CS2 in the carbon column. Per the chemists, this can't be done. The data in the Landfill ETL states that the average concentration of H2S in landfills is 250 ppm. As the 8 hr exposure to H2S is 10 and the 1 min STEL is 15 ppm, this is an extremely dangerous gas and should not be breathed. Olfactory fatigue will soon stop you from smelling it at all. This could be deadly. Contact the project chemist for information on suitable H2S measuring instruments to use for this. A quantitative test that measures the concentration of the H2S from the influent and effluent of the carbon unit over time should be used. This will provide a breakthrough curve for the H2S and better define the amount of carbon used. It will also show whether or not carbon is needed at all. Untreated H2S when burned to S02 in the flare may or may not exceed the states SO2 emission limits so the H2S may or may not need to be removed.	CENWO-ED-DK O. Nalbant	Referenced spec section has been revised. During the pilot test, hydrogen sulfide will be measured by a H2S monitoring/measuring equipment. Also, use of a field kit was specified in the specs for H2S concentration measurement during the periodic sampling/testing.
40	*Specifications* Spec No. 11241 General	CENWO-HX-E E. Mead	Add a section as per Paint Section in 11240-11/3.4.	CENWO-ED-DK O. Nalbant	Added.
41	*Specifications* Section 13570 General	CENWO-HX-E E. Mead	Add a flare exit gas temperature measuring/warning instrument to be sure gases in the stack don't get hot enough to melt the stainless steel clips holding the soft ceramic packing, etc. (this happened on another landfill flare).	CENWO-ED-DB R. Guziec	Concur.

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42	*Specification* Spec No. 13570 Section 5.1.1	CENWO-HX-E E. Mead	In Table 1 of the DA p 2-6 the "range factor" for methane is 5.2 percent. Also the average concentration from averaging the values listed is 8 percent. Verify that the landfill methane concentration is 40-60 percent as in the specs and not 8 percent.	CENWO-ED-DB R. Guziec	Concur. The specs will be changed to agree with the DA.
43	*Specifications* Spec No. 01800 Section 2.7	CENWO-HX-G G. Mellema	Insert word "Operate" and maintain...	CENWO-ED-GB R. Taylor	Concur.
44	*Specifications* Spec No. 02252 Section 1.1	CENWO-HX-G G. Mellema	ASTM D 1785 is for PVC and HDPE is specified. Revise.	CENWO-ED-GB R. Taylor	Specification 02252 will be revised to reflect changes based on comment 4.
45	*Specifications* Spec No. 02271 Section 1.4	CENWO-HX-G G. Mellema	The geomembrane with bentonite backing (Gundseal) will not be stable on the 4:1 slopes. Only a reinforced GCL will perform on sloped areas. However, the Gundseal product would perform adequately on the flatter areas of the cover system. May want to consider deleting the reference to the geomembrane backed GCL in this paragraph 2.1 of section 2442.	CENWO-ED-GB R. Taylor	Specification 02442 will be revised to clearly state that a reinforced GCL is required. This specification will be replaced by a more current version.
46	*Specifications* Spec No. 02273 Section 2.1	CENWO-HX-G G. Mellema	Table 1. Change transmissivity from 20 sq. meters/sec to 20 gallons/min/foot, or change value as appropriate for sq. meter/sec.	CENWO-ED-GB R. Taylor	The units for transmissivity were incorrectly labeled as 20 square meter per second in the specification. The correct units are 20 gallons per minute per foot (gpm/ft). The transmissivity requirement for the geonet will be revised to read20 gpm/ft. In addition, calculations on page A-22 and A-23 of Appendix A will be revised to correct the units from gpd to gpm. Note that except for the conversion calculation, all calculations were correct with the exception of the units. This will result in changes to Design Analysis Appendix A and Specification 02273, Geonet has been replaced by Section 02273, Geocomposite.
47	*Drawings* Sheet C1.13	CENWO-HX-G G. Mellema	Access Road B Sections. Label the top of the geosynthetics and the gas vent header pipe where appropriate.	CENWO-ED-DJ D. Klima	Concur.
48	*Drawings* Sheet G1.01	CENWO-HX-G G. Mellema	Indicate with a note where the logs for the borings and trenches can be found.	CENWO-ED-GB R. Taylor	Concur. Note will be added to drawing.

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49	*Drawings* Sheet G8.03	CENWO-HX-G G. Mellema	Recommend that the number of settlement gages be reduced to 5 or 6. If more are needed, they can be added in the future.	CENWO-ED-GB R. Taylor	The number of settlement gages will not be changed. As currently designed, the gages can be used to monitor the slope of the header pipe for the vertical landfill gas extraction wells. The additional cost of construction of the monitoring points is not significant. The frequency at which the gages will be surveyed can be altered in the future as needs dictate. However, if they were installed at a later date, potentially useful data from the initial few years of operation would not be available. No changes are required to the submitted documents.
50	*Drawings* Sheet G8.04	CENWO-HX-G G. Mellema	Gas Monitoring Probes. I assume that the probes GMP-4 through 10 are located south of the waste materials that are to be left in place. If one of the probes detects methane in excess of 10% of the LEL, it may be difficult to tell if the methane came from under the cover system of from the uncovered waste materials. Perhaps a couple of probes could be placed just south of the southern drainage ditch to help determine the effectiveness of the gas collection system.	CENWO-ED-GB R. Taylor	Concur. EPA is currently in the progress of further evaluating this area. Based on the results of this investigation, the monitoring scheme can be modified.
51	*Drawings* Sheet GD.01	CENWO-HX-G G. Mellema	Perimeter Drainage Pipe. Recommend hat a few clean out risers or access points be installed for O&M of the pipe.	CENWO-ED-GB R. Taylor	Concur. Clean-outs will be added along the drainage pipe. This will result in changes to Drawing G7.01 through G7.04, Final Grading Plan Sheets 1 through 4, a typical detail will also be added either to an existing detail drawing or to a new drawing; Specification 02730, Subdrainage System for Landfill Cover Systems and OM&M Plan, Section 2.
52	*Drawings* Sheet GD.01	CENWO-HX-G G. Mellema	Typical Drainage Ditch Detail. Recommend that the drainage pipe be lowered 1 foot into a rock "french drain" with the geonet over the top and the geomembrane underneath. As shown, there will be only 1 foot of cover over the pipe, surface water from the ditch can easily fill the pipe from above, thus water will not be able to drain effectively from the geonet. The additional depth will drain the geonet better, and reduce infiltration from surface water into the ditch.	CENWO-ED-GB R. Taylor	Concur. The pipe was located as shown to minimize the potential for placement of the cover system geosynthetics in the wet if a high ground water condition were present at the time of construction. However, if this situation did arise, it would likely only occur near the outfalls of the pipes at the riprap drop structures. Localized areas such as this could be drained by cutting a channel to the ponds to lower the water level and allow material placement. This will result in changes to Drawings G7.01 through G7.04, Final Grading Plan Sheets 1 through 4, and GD.01, Typical Cap Details.
53	*Drawings* Sheet M1.1	CENWO-HX-E E. Mead	Plan view of treatment system lacks detail. Recommend the specs state that the contractor develop a detailed plan view of equipment for approval. This will assure that the building is correctly sized.	CENWO-ED-DB R. Guziec	Concur.

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54	*Drawings* Sheet M1.2	CENWO-HX-E E. Mead	Need an oxygen monitor/alarm that is interlocked with the butterfly valves #1 and #2 coming from the wells and the blowers to stop the flow of landfill gas if oxygen should get into the lines and create an explosive gas mixture.	CENWO-ED-DB R. Guziec	Concur.
55	*Drawings* Sheet M1.3	CENWO-HX-E E. Mead	In addition to the ladder diagram, the specs should require the contractor to submit a written narrative of each logic control item so there is no misunderstanding as to how the controls are to work and interact. I.e. The time delay relay TD-1 is normally closed except for a 10 minute period when the moisture separator is draining to the condensate storage tank...etc.	CENWO-ED-DB R. Guziec	Concur.
56	*Draft OM&M Plan* Preface page	IDEM T. Likins	The final OM&M plan should come from the design contractor, not the construction contractor. Also, Volume 2 is not included. It appears Volume 2 may contain the Construction QAPP (previously noted as missing in the General Comments section of this letter). The Construction QAPP must be approved prior to construction, not after it.	CENWO-ED-GB R. Taylor	It is felt that the final OM&M Plan can not be developed for the site until after construction is substantially complete. Specific equipment operational details, catalog cut-outs, maintenance schedules, etc. will not be available until after the equipment is purchased and installed. As a result, this information can not be included in the Draft OM&M Plan. In addition, details related to actual as-built conditions, finished elevations and coordinates of wells, etc., will also not be available until completion of construction. The construction contractor is required to submit a revised OM&M Plan per Specification 01730, Site Operation, Maintenance, and Monitoring Manual, which includes the information stated above. This plan must be approved by the contracting organization in coordination with regulatory agencies prior to acceptance of work. Volume II was not included because it will contain the as-built drawings and final technical specifications with all modifications or amendments included. A draft table of contents was submitted as part of Volume I of this document. This is noted in the preface to the OM&M Plan. No changes are required to the submitted documents.
57	*Draft OM&M Plan* Section 2 Para 2.1.5.9 to 2.1.5.11	EM T. Likins	Will the landfill gas treatment system components be housed in a single maintenance building, multiple buildings, or exposed to the elements (and trespassers)?	CENWO-ED-GB R. Taylor	The landfill gas treatment system will be located within a fenced enclosure as shown on Drawing C1.09, Landfill Gas Treatment Facility, Detail Site Plan. This fenced enclosure is in addition to the site's perimeter security fencing. The equipment will be covered with a roof structure to minimize exposure to the elements as shown on Drawing S4.01, Landfill Gas Treatment Facility, Roof Sections and Details. No changes are required to the submitted documents.

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58	*Draft OM&M Plan* Section 3 Para 3.1	IDEM T. Likins	The Standard Operating Procedures for the LFG collection and treatment system should be finalized by the designer of the system, not the operator of the system.	CENWO-ED R. Guziec O. Nalbant R. Taylor	Refer to Comment No. 56. Additional detail related to design assumptions will be added to the operating section of the manual.
59	*Draft OM&M Plan* Section 3 Para 3.2	IDEM T. Likins	The use of an underground storage tank for leachate could pose problems over a 30 year O&M period. The use of an above ground tank is suggested.	CENWO-ED R. Taylor	Per direction form EPA, the underground storage tank will be utilized.
60	*Draft OM&M Plan* Section 3 Para 3.5	IDEM T. Likins	States that the gas temperature will not be allowed to drop below 125 degrees F. but does not explain how this will be done.	CENWO-ED-DB Guziec	The statement in the Draft O&M Plan should read that the gas temperature will not be allowed to be in excess of 125 degrees F. The document will be changed.
61	*Draft OM&M Plan* Section 3 Para 3.6.2.2 & Table 3-1	IDEM T. Likins	As mentioned in the General Comments, Elkhart County is a non-attainment area. This may necessitate altering the sampling frequency and sampling analysis parameters.	CENWO-ED-DK N. Naraine	Noted. The Federal ozone non-attainment regulations will be reviewed and the design will be changed to meet the requirements.
62	*Draft OM&M Plan* Section 3 Para 3.8	IDEM T. Likins	No monitoring is listed for emissions from the flare. Is the flare expected to have zero emissions? Also, the flare is not mentioned in the Design Analysis document.	CENWO-ED-EG N. Narraine	Although the flare is expected to have no VOC or SVOC emmisions due to the GAC units, the flare will be monitored for point source emissions as required by State ARARs. The flare monitoring scheme has been added to the specifications.
63	*Draft OM&M Plan* Section 4 Para 4.1.1	IDEM T. Likins	States that a list of all settlement gauges and survey monuments is provided in Appendix D. They are not in Appendix D and could not be found elsewhere in the document. Their inclusion is necessary.	CENWO-ED-GB R. Taylor	Refer to Comment No. 56. This Appendix contains typical forms that will be used to record the required information for the monuments and gages. Once the survey monuments and settlement gages are installed and surveyed, this form would be completed to reflect as-built conditions. No changes are required to the submitted documents.
64	*Draft OM&M Plan* Section 4 Para 4.2.3	IDEM T. Likins	Sampling should be monthly for months 2 through 6, instead of every two months. Also, no monitoring of total VOC emissions (or any other emissions) from the treatment system is mentioned. The monitoring of emissions from the system must be done to ensure compliance with Sate and Federal ARARs.	CENWO-ED O. Nalbant R. Guziec D. Morrissey R. Taylor	Concur. The sampling frequency will be changed. An emissions monitoring scheme for emissions from the flare has been included in the specifications.

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65	*Draft OM&M Plan* Section 5	CENWO-HX-H T. Tomasek	It is best if there is only one Site Safety and Health Plan (SSHP) instead of every Contractor trying to have a complete SSHP. All employees for all contractors will be required to read and sign that they have read and will comply with all requirements of the SSHP. Each contractor will be required to read and sign that they have read and will comply with all requirements of the SSHP. Each contractor will be required [to] develop a SOP for their activity that will cover all of the different tasks and a hazardous analysis for each task that their employees will perform. This section also needs to be expanded on so there isn't any question that OSHA requirement along with EM 385-1-1 are to be followed.	CENWO-ED-EH D. Morrissey	The OM&M manual will be revised to indicate that the prime construction contractor is responsible for developing and implementing a general site safety and health plan (SSHP) that is in accordance with OSHA regulations. Contractors working at the site will be required to update or provide addendums for work that is not covered in the general SSHP. The post-closure operating contractor will be required to update the SSHP. This requires changes to Section 5 of the OM&M plan.
66	*Draft OM&M Plan* Section 8 Para 8.4	IDEM T. Likins	EPA and IDEM should be notified immediately after discovery of critical systems failure or off-site migration of landfill gases, not within 24 hours. However, the local authorities should be notified first (and always, because this situation always warrants their notification).	CENWO-ED-GB R. Taylor	The text will be revised to show that IDEM and EPA will be notified within 2 and 24 hours of an incident, respectively. This will result in changes to Section 8 of the OM&M Plan.
67	*Draft OM&M Plan* Section 8 Para 8.8.2	IDEM T. Likins	What will be done about escaping landfill gas if the cover system fails?	CENWO-ED-GB R. Taylor	The area will be monitored. No attempt to capture escaping gases will be made. A discussion on monitoring requirements will be added to the OM&M Plan. This will result in changes to OM&M Plan, Section 8.
68	*Draft OM&M Plan* Section 8 Para 8.8.3.1	IDEM T. Likins	Venting to the atmosphere should only be used as a last resort and only until a temporary treatment system can be activated.	CENWO-ED-GB R. Taylor	Concur. The text currently states that venting will only occur if the system will be unoperational for an extended period of time and/or there is the potential for a buildup of gases. However, additional text will be added to indicate that repairs of the system must be completed expediently and reference section 8.4 which discusses notification of regulatory agencies and submittal of remedial action plan and schedule. Text will also be added that the residents east of the site will be notified if such an event occurred. This will require changes to OM&M Plan, Section 8.
69	*Draft OM&M Plan* Section 8 Para 8.9	IDEM T. Likins	If any landfill gas is ever discovered off-site at or near a residence or public roadway, continuous monitoring will be implemented.	CENWO-ED-GB R. Taylor	Current phrasing of the text allows the State to require continuous monitoring. Text will be added to indicate that continuous monitoring will be required until the extent and magnitude of the problem are determined and appropriate monitoring locations and frequencies established. This will require changes to OM&M Plan, Section 8.9.

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70	*Draft OM&M Plan* Figure 4	IDEM T. Likins	Additional landfill gas probes should be considered for the west and north areas.	CENWO-ED-GB R. Taylor	As currently designed, the areas to the west and north will be used for borrow areas. This will result in the expansion of the existing ponds and the creation of wetland areas. The presence of water along these sides of the landfill will serve as a subsurface barrier to gas movement. In addition to the presence of a defacto barrier, there are currently no residences or other developments near these areas that could be affected by migrating gases. Note that there is one probe located at landfill gas treatment facility to monitor for gas migration in this area. No changes are required to the submitted documents. Also refer to Comment No. 50.
71	*Draft OM&M Plan* Appendix A	IDEM T. Likins	Contact phone number for the IDEM Superfund Section is (317) 308-3120. The phone number for IDEM Emergency Response Section should also be included, it is (317) 233-7745. This is a 24 hour number.	CENWO-ED-GB R. Taylor	Concur. This information will be added. This will result in changes to OM&M Plan, Appendix A, Points of Contact, General Table.
72	*Draft OM&M Plan* Appendix G Section 1.3	IDEM T. Likins	The monitoring schedule should be monthly for months 2 through 6. Also, any one on-site for maintenance or other reasons should use personal monitoring equipment while at the site.	CENWO-ED-GB R. Taylor	Concur. This monitoring schedule will be revised as indicated. This will result in changes to OM&M Plan, Section 4.2.3 and Table 4-2 and Appendix G, Section 1.3 and Table G-1.
73	*Draft OM&M Plan* Appendix G, Section 1.4.2	IDEM T. Likins	How will the on-site barometric pressure be accurately determined at the time of sampling?	CENWO-ED-GB R. Taylor	A barometer will be installed at the treatment facility. This will result in changes to OM&M Plan, Section 1.4.2.
74	*Draft OM&M Plan* General	CENWO-HX-E S. Hanson	A recommendation on this Operation and Maintenance work is that an O&M cost estimate be prepared.	CENWO-ED-CC R. Stricker	Noted.
75	*Draft OM&M Plan* Appendix H Para 1.4.1	CENWO-HX-C J. Solsky	The cyanide method was left out of this section but included in later sections. The requirement for cyanide should be verified.	CENWO-ED-EG N. Naraine.	Concur. The cyanide method will be added.
76	*Draft OM&M Plan* Appendix H Para 1.5	CENWO-HX-C J. Solsky	It would be recommended that the definition stated for 'Analytical Batch' be revised. The definition presented in blending the concepts of the preparation batch and the analytical batch.	CENWO-ED-EG N. Naraine.	Concur. Definition of batch will be revised.

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77	*Draft OM&M Plan* Appendix H Para 2.1	CENWO-HX-C J. Solsky	The last paragraph gives 'reporting limits' such that DQOs can be achieved and then lists appropriate 'detection limits' for this task. These two terms are not equivalent. It would be recommended that this be clarified. A reporting limit is what the lab notes on their report forms and should be no lower than the low standard used during the initial calibration. A detection limit is lower than the reporting limit and represents the lowest concentration that the lab can determine the presence only of a given target analyte. A lab's reporting limit must be at least 3 to 5 times the laboratory's method detection limit.	CENWO-ED-EG N. Naraine.	Concur. Detection limits and reporting limits will be defined. Disagree with the statement " A lab's reporting limit must be at least 3 to 5 times the laboratory method detection limit."
78	*Draft OM&M Plan* Appendix H Para 2.2.4.1	CENWO-HX-C J. Solsky	See the previous comment [No. 76]. It would recommended that this section be expanded to better describe the relationship between the laboratory's 'method detection limit', 'method reporting limit', 'low standard used during initial calibration', and 'site specific actin limits'. The 'laboratory reporting limit' should be below the 'site-specific action limits'. The 'laboratory's reporting limit' should be at or above the 'low standard used during initial calibration'. The 'low standard used during initial calibration' should be between 3 to 5 times the laboratory's 'method detection limit'.	CENWO-ED-EG N. Naraine.	Concur. See above response to comment #77.
79	*Draft OM&M Plan* Appendix H Para 2.3	CENWO-HX-C J. Solsky	It would be recommended that an initial audit also be conducted by the CX.	CENWO-ED-EG N. Naraine.	Disagree. The CX initial audit would only be needed on a Corps "fund lead" project and isn't performed on an EPA Superfund PRP project unless requested by the EPA.
80	*Draft OM&M Plan* Appendix H Para 6.3	CENWO-HX-C J. Solsky	It would be recommended that this paragraph be expanded. This section should clearly state that all reported target analytes should fall between the low and high standards on the initial calibration curve and be bracketed by passing CCVs. Compounds can be reported below the low standard or above the high standard but only as estimated values. All initial calibration curves should be verified with a mid-level independent source standard for all target analytes.	CENWO-ED-EG Naraine.	Concur. Paragraph will be expanded to meet the SW-846 criteria.
81	*Draft OM&M Plan* Appendix H Para 6.3.2	CENWO-HX-C J. Solsky	It would be recommended that the requirement for second column confirmation also be addressed.	CENWO-ED-EG Naraine.	Concur. Second column confirmation will be specified.
82	*Draft OM&M Plan* Appendix H Para 6.3.3	CENWO-HX-C J. Solsky	It would be recommended that all method target analytes be evaluated for both the initial calibration and the continuing calibration verification.	CENWO-ED-EG Naraine.	Concur.

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83	*Draft OM&M Plan* Appendix H Para 6.3.5	CENWO-HX-C	It would be recommended that if the initial calibration curve is to consist of only a single standard and a blank (three standards and a blank would be preferred) that calibration be verified at both a mid-level and a low-level (at the reporting limit). The AA method requires that the initial calibration curve consist of three standards and a blank.	CENWO-ED-EG N. Naraine.	Concur. Will specify the verification of calibration with one standard and a blank.
84	*Draft OM&M Plan* Appendix H Para 6.4.2.1	CENWO-HX-C J. Solsky	It would be recommended that the spiking level be addressed in this section. Spiking should be performed at concentration equal to the site-specific action level.	CENWO-ED-EG N. Naraine.	Concur. Spiking shall be defined.
85	*Draft OM&M Plan* Appendix H Para 6.4.2.7	CENWO-HX-C J. Solsky	It would be recommended that this section be expanded to state that the LCS should contain all of the method target analytes spiked at the site-specific action level.	CENWO-ED-EG N. Naraine.	Disagree. LCS will contain at a minimum compounds of concern.
86	*Draft OM&M Plan* Appendix H Para 6.5	CENWO-HX-C J. Solsky	It would be recommended that this section be expanded to describe the minimum corrective actions required for certain failures. The Laboratory QA/QC officer is normally not the person who initiates corrective action within the laboratory. Such a position could monitor all such actions and verify that the appropriate corrective action was taken when an out of control situation existed.	CENWO-ED-EG N. Naraine.	Concur. Certain corrective actions will be specified for certain failures.
87	*Draft OM&M Plan* Appendix H Para 6.7.1	CENWO-HX-C J. Solsky	This section states that the first level of review will be conducted by the laboratory QA/QC Officer. This is incorrect and should be corrected. Level I data review is normally performed by the analyst and involves a 100% review of the generated data. Level II review is normally performed by a pier chemist and involves at least a 25% of the generated data. Level III data review is an administrative review. The QA/QC Officer would normally randomly review about 5 to 10% of the completed laboratory data reports and is not part of the normal day-to-day production of these data reports. The remainder of the information in this section is incomplete and should be restructured using the scheme presented in this comment.	CENWO-ED-EG Naraine.	Concur. Will change as suggested.
88	*Draft OM&M Plan* Appendix H Para 6.7.2.1	CENWO-HX-C J. Solsky	It would be recommended that the checklists presented be expanded. Many items are missing from the checklists presented. For example, for the metals, the review of the serial dilution and post-digestion spikes is missing. Also missing is a review of the inter-element check standards and all of the calibration information.	CENWO-ED-EG N Naraine.	Concur. Checklist will be expanded.

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NO	DOCUMENT & SECTION	COMMENTOR	COMMENT	RESPONDER	RESPONSE
89	*Draft OM&M Plan* Appendix H Table SAP-4	CENWO-HX-C J. Solsky	It would be recommended that this table be expanded to include all preparative methods along with which method updates are to be used.	CENWO-ED-EG N. Naraine.	Concur. Will add sample prep. methods.
90	*Draft OM&M Plan* Appendix H Table SAP-6	CENWO-HX-C J. Solsky	It would be recommended that the surrogate 'Dibutylchlorendate' be changed for the Pesticide method. This is an older surrogate that is no longer in use and prone to interferences. The use of surrogates TCMX and DCB is now recommended.	CENWO-ED-EG N. Naraine.	Concur. Will change to the new surrogates.
91	*Draft OM&M Plan* Appendix H Table SAP-7	CENWO-HX-C J. Solsky	It would be recommended that the LCS contain all method target analytes spiked at the site-specific action limits.	CENWO-ED-EG N. Naraine.	Concur with the spiking levels. Disagree with "all the method target analytes." See response to #85.
92	*Draft OM&M Plan* Appendix H Table SAP-8	CENWO-HX-C J. Solsky	The ranges presented for the matrix spikes should be the same as the ranges presented for the laboratory control samples. It would be recommended that if a subset of the target analytes are used for the matrix spike, that the subset chosen be representative of all of the target analytes. For example, for the volatile organics the spiking list does not contain any ketones	CENWO-ED-EG Naraine.	Concur. Will change as suggested.
93	*Draft OM&M Plan* Appendix G Para. 1.4	CENWO-HX-H T. Tomasek	A combustible gas meter is not the best choice for a direct reading for landfill gases. There will be a lack of oxygen in the landfill gases so the meter reading may not be correct. A better meter to use would be a IR instrument that would read both Methane and *Carbon Dioxide.*	CENWO-ED-GB R. Taylor D. Morrissey	Concur. An IR instrument will be utilized as suggested. The OM&M Plan will be changed to reflect the use of this instrument.
94	*Drawings* Sheet GD.01	CENWO-ED-GB R. Taylor	See Response	CENWO-ED-GB R. Taylor	Drawing will be revised to show textured geomembrane on 1V to 4H side slopes and smooth geomembrane on 4% top slopes. In addition, a double layer of geocomposite will be shown below the geomembrane on the 1V on 4H side slopes. An additional detail will be developed to show both the 1V on 4H side slope and 4% top slope details. This will require changes to Drawing GD.01 and potentially add a new detail drawing.

Notes:
1. The 100 percent Design Analysis has been reformatted. As a result, the 90 percent page and section references are no longer applicable.